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THE GREAT GAS METER OF THE CONSOLIDATED GAS COMPANY OF NEW YORK.

We have already illustrated in this paper the largest pair of gas holders in the world. Though they belong to England, and though there are no gas holders in this country that can compare with this colossal pair, the great meter shown on this page is to be seen in this city. It stands in the meter house of the 21st Street station of the Consolidated Gas Company. In drum capacity, or actual working power, it is the largest in the world.

The case is cylindrical, and is made of cast iron. The heads are each in four segments, bolted together by radial flanges. This not only obviates the necessity of making castings of such difficult size and shape, and so liable to warp, but it also secures a strong piece of work. The flat heads of large meters spring more or less on account of the water pressure exerted upon them. The flanges in the construction shown stiffen the heads, so that little or no springing takes place. In England, as a rule, square cases are used for meters. These are not favorites here, as when large they require much internal bracing to enable them to resist the pressure. As a cylindrical drum is the object to be inclosed, a case of corresponding shape seems the most logical.

The drum is made of heavy tin plate. It is built on an elaborate frame of angle and T-iron, perforated for rivets where required. This frame was constructed from an exact model made of tin, and of small size. Over the large frame, the duplicate of the small one, the tin was riveted, the rivets soldered, and the edges and joints of the sheets solidly soldered together.

The case was taken through an opening broken through the side of the building for the purpose, and placed upon its foundation piers. The drum was set up and completed on the floor in front of the case, and then was placed in position within it. This was an operation of peculiar difficulty, occupying a number of men several days. Its weight was six tons, and this had to be handled with the utmost care, for fear of deformation. All the prying and lifting had to be done against the iron frame. The tin was not touched, lest it should be bent.

The old way of constructing drums was to provide them with fixed shafts. These rested in journals, and rotated with the drum. In the meter we are describing, a departure was made from this method. A stationary shaft reaches from back to front of the meter case, resting on brackets attached to the heads. The drum is carried by this shaft, and has journals in its center pieces, and revolves around it like an idle pulley. This is considered an advance on the old construction.

The usual disposition of inlet and outlet pipes and of index plate is followed. The gas enters at the center of the back plate. It goes through the drum, turning it on the principle of an Archimedes screw as it does so, and emerges from the drum into the case and leaves it by the outlet pipe. This is also connected to the back head, to one side and above the inlet pipe. These inlet and outlet connections are of 30 inches internal diameter. The index plate occupies the center of the front face. It contains the long row of dials indicating the amount of gas passing, arranged in a circular arc, and within the arc is a clock.

The case is 17 ft. 9 in. in length, and 18 ft. 6 in. in outside diameter. Its drum capacity is 3,000 cubic feet. This means that in each revolution it delivers that quantity. Its capacity per day of twenty four hours is placed at 4,500,000. This is based on a general drum speed of one revolution per minute Unquestionably it could far exceed this amount, and could probably dispose of 6,000,000 cubic feet per day.

It would be hard to find any mechanical construction of such simplicity, yet so hard to describe and understand thoroughly as a wet gas meter. If the reader can picture to himself an Archimedes screw extending through an angle of 180° only, he will have a correct idea of one of the compartments of a meter drum As a rule, there are four such compartments. In the small drawing we show the construction. A drum is there represented, part of the outside cylinder and cap being cut away to show the interior. A cylinder has its interior divided by four partitions that are slightly helical. At the back and front, quadrant plates are soldered to these and to the edge of the cylinder. These plates are a little inclined outward from the plane of the base of the cylinder. They run in opposite directions to each other, so as to carry out the general helical direction of the partitions, but far more abruptly and about at right angles to the partitions. The free edges of these two partitions lie almost in the same plane, parallel to the axis of the drum, and nearly coincident with two radii.

The plane determined by these two edges is the correct water level. The drum is immersed to that depth in water. The threefold partition described, being repeated four times, gives four helicoidal divisions. As the quadrants or "hoods" dip under the water they close one end of a division. This immersion coincides with the lifting of the other hood from the water. Hence, when a partition is open at one end, it is closed at the other. If gas is entering a division, it cannot

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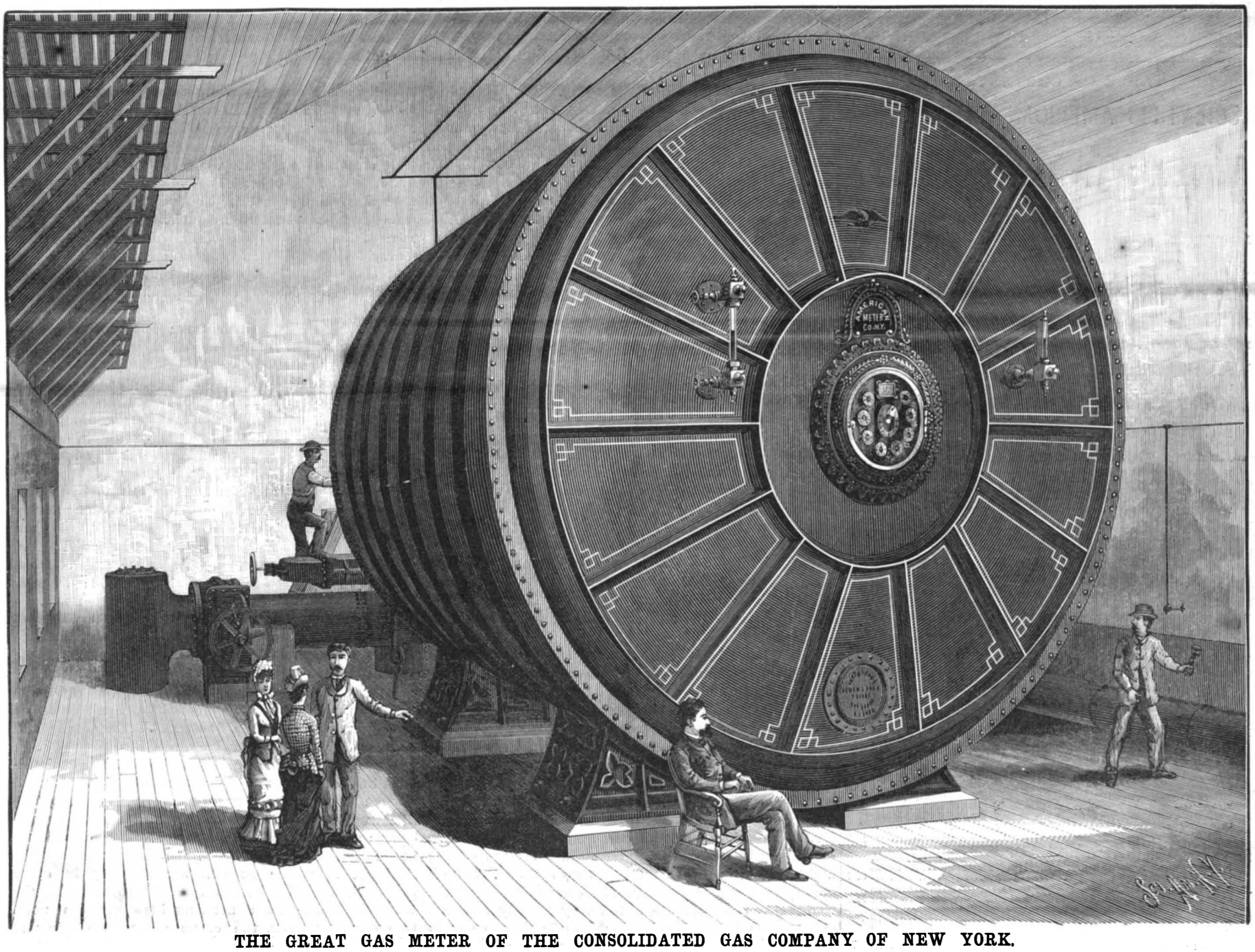

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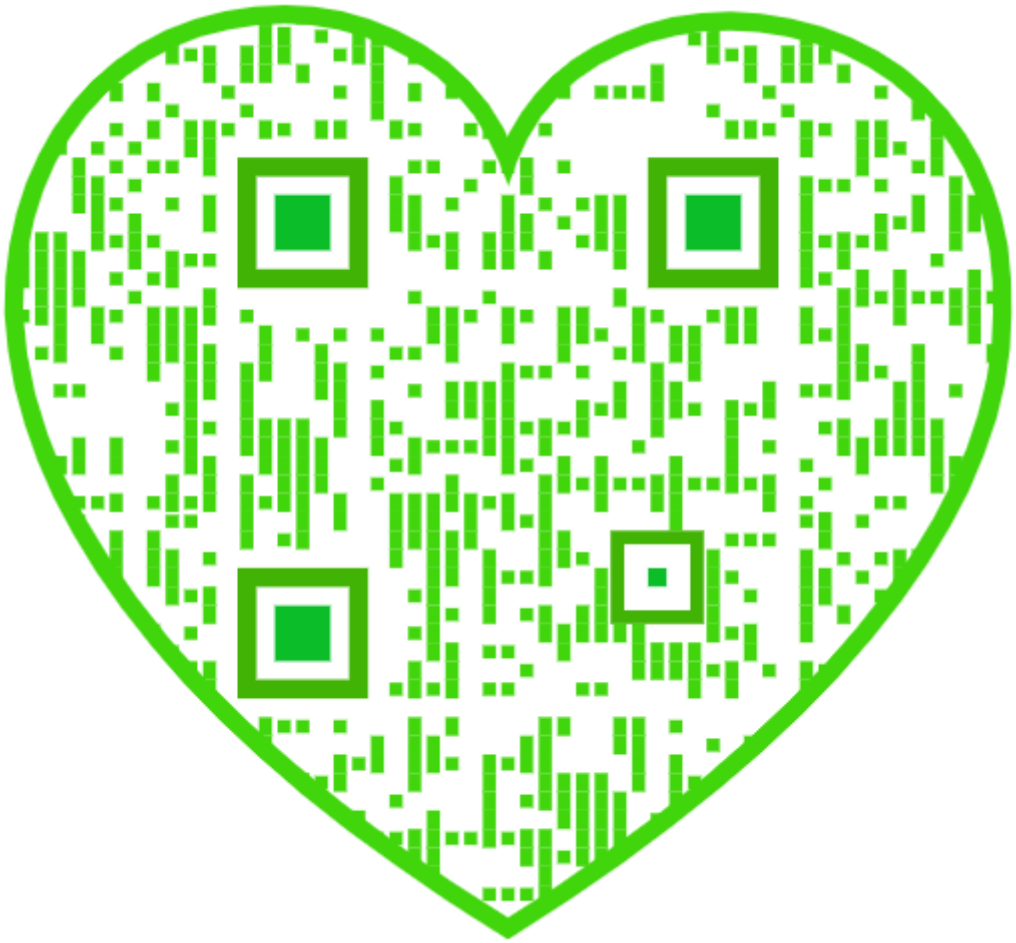

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THE NAVY'S NEEDS.

The condition of the navy is attracting more attention than it has received at any previous time since the close of the war. Naval officers and a few legislators have long known—and the fact is now generally admitted by the press and the people—that we have not had during the last twenty years a single sea-going ship that would have had a hope of victory if pitted against any of the first-class warships of other nations launched during that time. During those twenty years, but one ship built by or for our government has been any more worthy to be called a modern warship than an old-time sailing frigate of the Constitution class would have been. This one exception was the Trenton, which, though unarmored and none too fast, was, when she was launched, a fairly efficient cruiser. Every dollar spent for construction or repairs outside of the Trenton has been wasted in the creation or perpetuation of ships utterly useless for war purposes. Most of these craft would not have rated high in their respective classes thirty years ago; yet in the face of all the improvements that have been made in other navies, we have gone on tinkering with these old hulls filled with mere scrap metal, called—by courtesy only—boilers, engines, and batteries. Within the past four years, four new ships have been designed and nearly completed, namely, the Chicago, the Boston, the Atlanta, and the Dolphin.

It is unnecessary to go into the controversy as to what measure of success or failure has attended the practical working of these ships, two of which are in commission, while the other two are nearly ready for their crews; assuming, even, that they will accomplish, in the matter of speed and seaworthiness, all that their specifications call for, they are still unsatisfactory specimens of naval architecture, and are costly but inefficient additions to the service. They are not armored for resisting heavy guns, and they have not speed enough for light cruisers. It is now proposed to build four additional steel cruisers, not armored, the proposed tonnage and speed being as follows, respectively: One of 4,000 tons, highest speed 18 knots; one of 3,730 tons, highest speed 18·9 knots; one of 1,700 tons, highest speed 16 knots; one of 870 tons, highest speed 12 knots. It is unnecessary to go into further particulars regarding these vessels, for the foregoing figures are sufficiently condemnatory without criticising the defects of the battery and the particular style of machinery. The two vessels having high speed are too large, while the smaller two are ridiculously slow.

The United States navy ought not to be intended for large offensive operations against land fortifications and heavy ironclads. So much has been admitted by the navy department in the construction of the last four and in the plans of the next four new ships. They are not armored for heavy fighting. They are called "cruisers," and while doubtless they can "cruise" well enough from port to port in time of peace, they ought to have been constructed with special reference to the requirements of war. They ought not to be fighters, but fliers, having the greatest speed and coal capacity consistent with a small but powerful battery. Except for coast defense, we do not need ironclads, but Alabamas.

Now, there is no objection to the speed of the two largest of the new cruisers, namely, 18 and 18·9 knots respectively. If that speed could be maintained for ten days, and if they could carry coal enough to last that time, they would be model "cruisers," for they could overhaul anything afloat; but unfortunately that is not intended to be their sustained speed, and it is not likely that even 15 knots could be kept up for any great length of time, or that they could carry sufficient coal for long steaming at great speed. Consequently, not being efficient as armored fighting ships, and not having even sufficient speed to escape from the first-class armored ships of other nations or to overhaul the fast merchant steamers whose capture would be desirable, it is difficult to see what effective service they could perform. As for the two smaller ships, a maximum speed of 12 and 16 knots respectively makes them, of course, even less satisfactory than the larger pair. It seems as though—following the example set in the Chicago, Atlanta, etc.—the Navy Department proposes to build ships that can neither fight nor run.

It is apparent that we must keep up a considerable naval establishment for two reasons: First, as a navy cannot, like an army, be created at short notice, an effective nucleus of trained officers and men must be maintained at all times; second, even in time of peace there are barbarous or semi-civilized nations with whom no arrangement is effective unless the power to enforce our rights is made clearly apparent. Therefore, we need a moderate number of cruisers to keep officers and men actively employed, and to visit the ports of all semi-civilized and barbarous nations frequently. The ships should not be so large as to be unduly costly to build and to keep in commission, but they should have high speed, large coal capacity, and a very few long range guns. For coast defense, a few very heavily armored ships of the Monitor type, capable of going to sea in ordinary weather, might be desirable, to meet a hostile fleet just outside our ports in case of a blockade or bombardment; but it is becoming more and more questionable whether these would be absolutely essential to our defense. In their place, a swarm of torpedo craft, Ericsson's Destroyer, and dynamite-gun carriers could be provided at very moderate expense, and there are few naval officers who do not admit that they would rather fight ironclads than torpedoes.

Finally, the navy wants to forget some things and learn some others. It especially needs to forget that vessels ever were propelled by the wind. If every manufacturer using a steam engine insisted on erecting a windmill over his workshop to assist the steam power below, he would be regarded as a "crank;" yet that is practically what many of the older naval officers insist upon on board ship. Because sails and spars were once necessities, they cannot see that they can be dispensed with now. They need to forget that it is necessary to follow the lead of European navies in preparing for a game of war. All the pretty little rules by which foreign experts prepare themselves to meet their European enemies may well be ignored and dispensed with, just as we always have ignored them when actual fighting was to be done. Modern naval warfare—in theory, at least, for there has been precious little practice—is beginning somewhat to resemble the middle-age tournaments in armor. The ships are now cuirassed instead of the knights, but the rigidity and cumbrousness of the combat are likely to be marvelously similar. We want none of this kind of training. We can get along without the armor and without the clumsy rules that its use necessitates. Let our naval officers study the weak points of their possible adversaries to avoid—not to copy—them, and exercise their ingenuity in inventing devices for resisting and repelling any attack that may be made on us.

The *personnel* of the United States navy—as universally admitted by foreign officers—has no superior in education, originality, quickness in device, and promptness in execution. If the government will only provide the right kind of ships, there need be no doubt that a good account will be rendered of them.

INCIDENTS IN BIRD LIFE AT THE PARK.

The curious behavior of a sheldrake in the Central Park Zoological Gardens has puzzled Superintendent Conklin and the keepers, and is attracting much attention among visitors. When the two sea lions were brought to the Park recently, this sheldrake was the only one among all the birds in the little inclosure outside the lion house, where the sea lion tank is, that took any interest in the new comers.

The sheldrake comes from Australia, where there are not any sea lions, and is, therefore, unacquainted with these monsters. Perhaps to this fact may be attributed the strong interest he took in them; for, ever since they were dumped into the tank, he has seemed to regard himself their special guardian, and spends the hours of each day on or near its edge.

He stands like a sentry, usually on one leg, and at first attacked the other birds, when they approached, with such fierceness that they seem now to have a wholesome dread of him, and at times, when very thirsty, sneak up to the basin, take a hasty sip, and scurry away as though they had come to the belief that the tank and its waters belonged exclusively to the sheldrake. Now, there are in this inclosure many large birds, such as the pelican, stork, and bittern—birds able to defend themselves; but, strange to say, they submit meekly to the assumption of proprietary right by this little wood duck, as if by some unseen, but potent, influence directed. The ponderous, sleek, and slow moving sea lions come up to the surface now and then, watch their little champion drive away intruders, and then, after blinking, sleepy-eyed, for a few moments, fall over lazily into the water and disappear.

The sheldrake is not known among naturalists as an aggressive bird, and hence to see him fly furiously at a great pelican, drive him from the field, and then send a long-legged sand bill crane scampering after in evident alarm, is a curious sight. While the sheldrake will allow no other bird to approach the sea lions by day, he relaxes his vigil after nightfall, when the sea lions and birds repair to the little house near the tank to sleep, and there is a tacit understanding that the other birds may then approach.

This sheldrake is of the sub-family *Anatinæ* and of the genera *Tadorna* (Leach) and *Casarka* (Bonap.). The species are to be seen on the sea shore as well as on the lakes, feeding on marine plants, crustaceans, and mollusks. The note is a shrill whistle.

Another interesting phase of bird life has been developed in the big cage on the eastern side of the arsenal, where a scarlet ibis (*Ibis rubra*) has taken a strong dislike to the note of the whooping crane (*Grus americana*); and, as if in furtherance of Oscar Wilde's suggestion as to an art police which should prevent discordance in music as well as deformity in other branches, this ibis essays forcibly to restrain the whooping crane from uttering his unmusical note. One day last week, the crane got to work in real earnest, and whooped away for nearly half an hour,

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pursued the while by the ibis, which, following him from one part of the cage to another, struck at him with his sharp bill after each note.

The note of the whooping crane somewhat resembles the cries of a human being in distress, and is not, therefore, pleasant to the ear.

Yet it would seem a refinement of sarcasm for a bird with a cry like unto that of the red ibis or the white ibis to object so vehemently to the screech of the whooping crane, for the note of the ibis while not unpleasing heard in the distance, has a harsh and uncanny sound when near at hand.

The intelligence of the ibis is well known, and those who have been along the Spanish Main will perhaps remember its cleverness when in pursuit of the crayfish. In the dry season, when food is scarce, the latter burrows some three or four feet beneath the surface, for he is not fairly comfortable save in the damp or moist earth. Coming upon one of these burrows, the ibis tumbles the earth back in the aperture, and the crayfish, shut off from the air, comes up to repair damages, and is seized by the ibis and devoured.

The ibis was worshiped by the Egyptians, and reared in their temples. Some saw a connection between the changes in its plumage and the phases of the moon, while others, because the inundation of the valley of the Nile took place just after the return of the ibis, were inclined to attribute this welcome phenomenon to its coming; tracing the rise and spread of the stream, which attracted the hungry birds, as the consequence rather than, as it really is, the cause of their appearance.

Herodotus has depicted the iris as a destroyer of serpents, which would seem to be a mistake, though he devours frogs, toads, and water lizards with evident relish.

The whooping crane is also from South America. It is found on the shores of large ponds and lakes, and occupies itself for the most part in delving for the roots of the great water lily, of which it is fond.

Life in the Formation of the Earth.

When we look at the surface of the earth, the vast strata of rocks and soil, we are not at first thought apt to consider the important part that life, in various phases, has taken in the formation of the visible part of the world as it now stands. To the earth life is indebted for its existence, and to life much of the earth's present form is due. They are and have been interdependent.

As rain falls from the sky it strikes sometimes upon clay and sometimes upon decaying vegetable matter; but in either case it eventually sinks deep into the earth, and finally finds its way back to the sea. When it strikes the earth, it has a very slight dissolving power, but, as it sinks, becomes compressed and charged with gases. Even the most insoluble substances can be taken up. Few elements are then free from its power. Charged with the various gases, it dissolves carbonate of lime, to be used in building marine shells, salt for the sea, and substances necessary to the existence of marine plants. Sea weeds, having no roots, must take elements necessary to their existence directly from the surrounding water. Bromine, iodine, potassium, gold, and silver must all be ready for them when needed, and it is to carbonic acid gas that they thus owe their existence. In the same way, corals and other calcareous structures are directly dependent upon this property of charged waters.

The water, passing through limestone rock, dissolves away the carbonate of lime, carries it to the coral polyp in the tropical waters, where it is appropriated by the animal, and left when the creature dies to be worn away by the waves and partly redissolved. What remains is piled up on the shore, where it afterward forms into hard coral rock. This is the cycle of the carbonic acid gas, and this the key to the formation of our coral reef, of our limestone and marble. In a similar way chalk has been formed. Various causes may unite to decompose these lime rocks, and the gas thus set free will aid in another cycle.

Life depends upon the sun for existence, and all life is either directly or indirectly made up of energy from the sun. Some of this energy may have come to-day, some ages ago; but, no matter when it came, it is solar energy. The beef we eat, the water we drink, simply give up latent heat taken from the sun; and this heat is what works our vital system and supplies us with energy. In other words, we are simply using up stored sunlight. In a given body, a plant, for instance, at the time of its death there is a certain amount of unused heat, which if the plant decays, is partly used up in decay. If the plant only partially decays, we have some sunlight or heat stored up for future use. This is the case of our coal. In ages past, millions of years perhaps, the solar heat poured down from a cloudless sky upon vast and magnificent forests of trees, which lived and died just as our trees do to-day; but, because they fell in damp places, they only partially gave up their solar heat. Then they became buried, and finally transformed into hard mineral. Thus by some wise provision of nature we have immense areas of coal, time-stored sunlight, ready for use; and now man is using these masses of coal and making them give up to him the sunlight which they have so carefully stored through their vast ages.

There are other ways in which vegetable matter has been accumulating so as to form parts of the earth's surface. At the end of the glacial period, over the northeastern portion of this country there were vast numbers of small, shallow lakes left, dotting the country here and there. When the frozen mass of snow and ice gradually receded, these were filled with clear, cold water; but the water and the earth about were utterly devoid of life. Soon the southern breezes brought spores and seeds of plants; then animals came. The water began to fill with life and sediment to be formed on the bottom; then the moss sphagnum took root on the banks of these lakes, and, according to its habit, began to grow out on the surface of the water, dropping sediment as it went; and year after year, growing further and filling in more and more, until, centuries having passed, the lakes became transformed into swamps of peat. This was the way our swamps were formed, and we have them even now in this same process of formation. In Ireland the far famed peat beds are examples. Here, in America, where coal is abundant, we have no need of peat, but when our supplies of coal are decreased, we have yet large tracts of peat to depend upon. In New England alone there are 2,000,000 acres of peat swamp.

In Kentucky there is a curious bed of carbonaceous shale, which, before the discovery of oil wells, was used for an oil supply. This use is now abandoned, but we may yet have to resort to it again. This shale was once a great sargassum sea in the midst of the geological ocean that covered our continent. Just such a bed is being formed in the Atlantic Ocean, by the accumulation of vast beds of sea weed beneath the sargassum sea, in the center of the eddy formed by the ocean currents.

The peat beds are formed by the dropping down of decaying matter from the surface, but our salt marshes are formed in just the reverse manner. In these the plants grow from the bottom, while the peat beds are mainly formed by deposition from the surface. Through some cause or other, by winds or eddies, a sand bank is formed in some sheltered bay or creek. As time passes, this grows shallower and the surface becomes rich with decayed matter of both animal and vegetable origin. Soon it is uncovered at low tide, and then we see something green growing upon the highest part. This is eel grass. Each year the grass decays until a sod is formed, which spreads as the bank becomes elevated, until the top is entirely covered with a layer of rich vegetable matter in a state of decay. Then the salt grass or marsh grass begins to grow, and soon only the highest tides flow upon what a few centuries back, was a bank of sand entirely covered with water. This formation, in every stage, may be seen on our sea coast. Vast areas of this kind of land extend along our entire Atlantic coast, and much of it might be reclaimed at very little expense, as has been done in England to large tracts of salt marsh.

These are a few of the strata in the earth which are due mainly to life for their present position. There are many others of minor importance, but these few mentioned best illustrate the principle of mutual dependence. When we think of it, we are surprised at the importance of life to the globe. Without its influence what a barren mass of rocks and soil we should have to live upon! It has shaped the continent moulded the contours of mountains, and made life easy. T.

The Bee's Sting a Useful Tool.

A new champion has arisen to defend the honey bee from the obloquy under which it has always rested. Mr. Wm. F. Clarke, of Canada, claims to have discovered, from repeated observations, that the most important function of the bee's sting is not stinging. In a recent article he says:

My observations and reflections have convinced me that the most important office of the bee sting is that which is performed in doing the artistic cell work, capping the comb, and infusing the formic acid by means of which honey receives its keeping qualities. As I said at Detroit, the sting is really a skillfully contrived little trowel, with which the bee finishes off and caps the cells when they are filled brimful of honey. This explains why honey extracted before it is capped over does not keep well. The formic acid has not been injected into it. This is done in the very act of putting the last touches on the cell work. As the little pliant trowel is worked to and fro with such dexterity, the darts, of which there are two, pierce the plastic cell surface and leave the nectar beneath its tiny drops of the fluid which makes it keep well. This is the "art preservative" of honey. A most wonderful provision of nature, truly! Herein we see that the sting and the poison bag, with which so many of us would like to dispense, are essential to the storage of our coveted product, and that without them the beautiful comb honey of commerce would be a thing unknown.

If these things are so, how mistaken those people are who suppose that a bee is, like the Prince of Evil, always going about prowling in search of a victim. The fact is that the bee attends to its own business very diligently, and has no time to waste in unnecessary quarrels. A bee is like a farmer working with a fork in his hay field. He is fully occupied, and very busy. If molested or meddled with, he will be very apt to defend himself with the implement he is working with. This is what the bee does; and man, by means of his knowledge of the nature and habits of this wondrous little insect, is enabled, in most cases, to ward off or evade attack. It is proof of their natural quietness, industry, and peaceableness that so many thousands of them will go through a summer of ceaseless activity close to your dwelling house, and perhaps not half a dozen stings be inflicted during a whole season.

The Coloring of Metals.

According to the *Illustrirte Zeitung fur Blechindustrie*, a grayish black coloring on copper may be obtained by placing the object for treatment, after being well cleansed, in a weak solution of liver of sulphur. When a caustic effect has, after a short time, been produced, the object is rinsed, slightly heated, and brushed with a stiff brush. This coating is said to be very durable.

A blackish brown bronzing can be applied to vases, figures, busts, etc., cast from zinc, by the application of a solution of sulphate of copper. If the projecting portions are then well rubbed with a woolen rag, they assume a coppery red brilliancy, which increases the resemblance to genuine bronze. A solution of verdigris in vinegar also produces an effective bronzing.

Brass may be colored black by repeatedly coating the cleansed metal with a moderately warm solution of nitrate of copper. Heating over a charcoal fire follows. Finally, the tone is heightened by rubbing with olive oil.

The Greatest of Great Walls.

Says a correspondent of the *Milling World*, who has recently been traveling in China: Of course we had to go to the great wall of China. This country abounds in great walls. Her mural defenses were most extensive—walled country, walled cities, walled villages, walled palaces and temples—wall after wall and wall within wall. But the greatest of all is the great wall of China, which crests the mountain range and crosses the gorge from here some forty miles away. Squeezing through the last deep gorge and a deep rift in the solid rock cut out by ages of rolling wheels and tramping feet, we reach the great, frowning, double bastioned gate of stone and hard burned brick—one archway tumbled in. This was the object of our mission, the great wall of China, built two hundred and thirteen years before our era; built of great slabs of well hewn stone, laid in regular courses some twenty feet high and then topped out with large, hard burned bricks, filled in with earth and closely paved on the top with more dark, tawny brick—the ramparts high and thick and castellated for the use of arms. Right and left the great wall sprang far up the mountain side—now straight, now curved, to meet the mountain ridge, turreted each three hundred feet—a frowning mass of masonry. No need to tell you of this wall; the books will tell you how it was built to keep the warlike Tartars out—twenty-five feet high by forty thick, twelve hundred miles long, with room on top for six horses to be driven abreast. Nor need I tell you that for fourteen hundred years it kept those hordes at bay, nor that, in the main, the material used upon it is just as good and firm and strong as when put in place. Twelve hundred miles of this gigantic work built on the rugged, craggy mountain tops, vaulting over gorges, spanning wide streams, netting the river archways with huge hard bars of copper, with double gates, with swinging doors and bars set thick with iron armor—a wonder in the world before which the old time classic seven wonders, all gone now save the great pyramid, were toys. The great pyramid has 85,000,000 cubic feet, the great wall 6,350,000,000 cubic feet. An engineer in Seward's party here some years ago gave it as his opinion that the cost of this wall, figuring labor at the same rate, would more than equal that of all the 100,000 miles of railroad in the United States. The material it contains would build a wall six feet high and two feet thick right straight around the globe. Yet this was done in only twenty years without a trace of debt or bond. It is the greatest individual labor the world has ever known.

A CORRESPONDENT writing from Caldwell, Kan., says: "Silver has been recently discovered in large quantities north and south of this city, where the lead crops out; in fact, it underlies the entire city about 36 feet from the surface, and extends several miles into the territory. It assays from $35 to $108 per 2,000 lb. rock.

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THE SUBMARINE MONITOR PEACEMAKER.

The subject of the illustrations accompanying this article is a small vessel that has attracted much attention during the last few months. It is a submarine boat designed for use in placing torpedoes under the bottoms of war vessels. It is the design of her owners, The Submarine Monitor Company, Fifth Ave. and 23d St., N. Y., to construct a larger vessel, to be provided with many additional improvements. Yet the little Peacemaker has obtained such success that, if the new craft does any better, it will be a subject of congratulation for those interested.

The Peacemaker is thirty feet long, seven and a half feet wide, and six feet deep. Many months have passed since we first described her. She has been changed in many respects since that period, and her efficiency has been the subject of numerous trials. Her name grimly suggests her mission. It is by her destructive powers to make marine warfare impossible at least as regards harbors or waters near ports.

In the original plan, the captain of the boat wore a diver's helmet and body piece. His head and upper part of the body projected above the deck of the vessel. This has now been changed. The present craft is provided with a small sighting dome, nearly amidships, and projecting fourteen inches or more above its deck. The captain stands directly under this, with his head in the dome. Four windows of plate glass, just large enough for his eyes to see through, permit his vision to range through the whole circle. As the presence of ships overhead has also to be made manifest to those within the boat, a bull's eye is set in the top of the dome. As she runs under a ship it can be discovered by this aperture. A pair of watertight sleeves and gloves are connected to the deck near the dome, so that external objects can be manipulated from within.

Among the accidents to which she was liable, one seemed peculiarly obvious. It was that by collision with some submerged object the dome, massive as it is, should be carried away. If this occurred, the boat would fill with water and sink. To avoid this danger, the boat is provided with a central fin extending the length of her deck, and rising about as high as the pilot's dome. This was designed to act as a fender, and it has proved a most valuable improvement. In its center it is provided with a notch or depression to catch the keels of vessels.

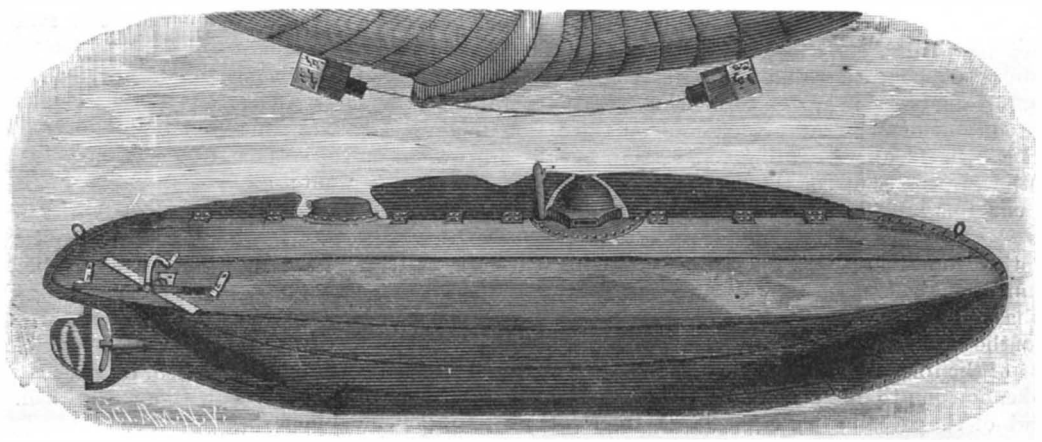
Her deck is also to be provided with torpedo gear for discharging floating torpedoes. The proposal is to release a pair of these engines attached to each other by a cord, and provided with cork floats, and electro-magnets, and electric detonators. When released, these will rise, one on each side of the keel of the vessel to be destroyed. A current of electricity is kept passing through the magnets. The instant they come in contact with the iron bottom of a war vessel, they will adhere with great tenacity. The Peacemaker, after placing the torpedoes, will steam away, and when at a safe distance explode them by electricity.

Her methods of sinking may be either by admitting water, so as to descend by want of buoyancy to any desired depth, or she may be driven down by deflection. At her stern, in addition to her ordinary rudder, a pair of horizontal rudders or deflectors are provided. The pilot can vary the angle of inclination so as to throw the stern upward. This causes the bow to pitch downward, so that the engine drives the vessel bodily downward. On stopping the engine, she floats upward to the surface in a few seconds. She is provided with pumps and all ordinary accessories of a vessel.

The great difficulty in submarine navigation has been to obtain an available source of power. In the Peacemaker, the Honigman soda boiler is used.* A reservoir for the reception of a strong solution of caustic soda represents the fire box. In this the boiler proper is immersed.

On starting out the boiler is filled with hot water. A strong solution of hot caustic soda, whose temperature may be nearly 500° F., is run into the tank. This soon generates steam. A fourteen horse power Westinghouse engine is used to drive the screw. The exhaust steam is blown into the soda solution. As it combines with the caustic soda it generates a great quantity of heat, thus replacing a fire and generating steam in the boiler.

Thus it will be seen that steam is the motive power of the boat. This is her strong point. Electricity has been tried, but has proved unsatisfactory. Any form of manual power is insufficient. Ordinary steam generators would rapidly exhaust the air. The soda boiler not only has none of these disadvantages, but also insures the presence of enough caustic soda to keep the air pure.



THE PEACEMAKER LEAVING A VESSEL.

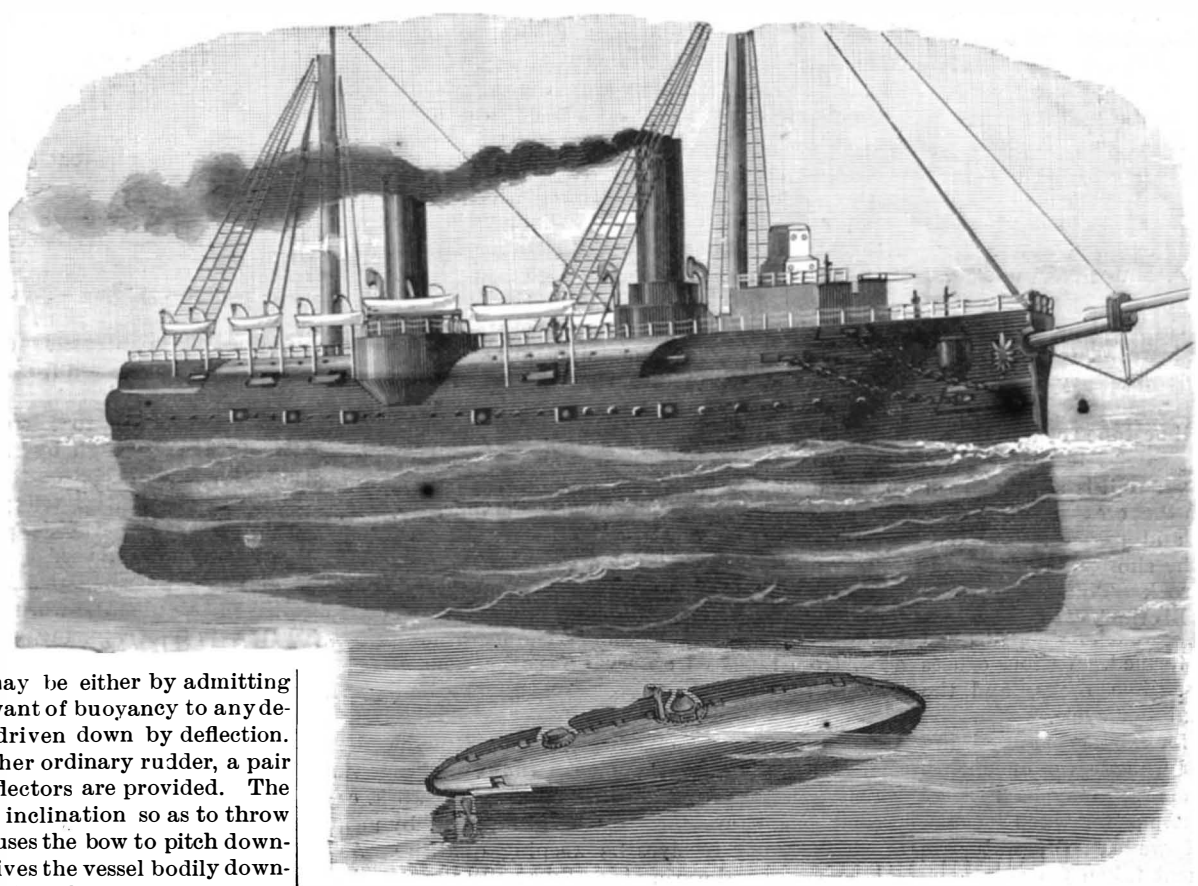
As the men are hermetically inclosed, some means in extended cruises will have to be adopted to purify the air. This is a very simple problem to solve. A cylinder of oxygen will be used to supply the gas as exhausted. As fast as carbonic acid gas is formed, it will be absorbed by caustic soda. Finally, a little chloride of lime or permanganate of potash will destroy organic impurities exhaled by the occupants.

Electric lights for illuminating the interior are used, as they do not contaminate the air.

Such is a brief description of what is termed the most successful submarine vessel ever constructed. The writer enjoyed a trip in her, and was much impressed with the ease with which she was handled. As her bow pitched down, the sensation of running down the incline was most peculiar, in addition to which a forward impetus of the body was felt, due presumably to the deflectors.

A pressure gauge is used to indicate the depth to which the vessel descends. In the ordinary trial trips, a depth of forty to fifty feet is attained.

The new Peacemaker is to have two sets of boilers, one for surface and the other for submarine use. She will have soda regenerating apparatus also, so as to be in some sense an independent cruiser, and not a mere tender on some larger craft.



THE PEACEMAKER APPROACHING A VESSEL.

* See SUPPLEMENT, No. 483.

A NEW fluid for preserving museum specimens, so as to keep their color, size, form, and consistency for several weeks, has been devised by Professor Grawitz. It consists of 150 grms. of sodium chloride, 20 grms. of saltpeter to 1 liter of water; to this is added 3 per cent of boracic acid.

Filtration of Water.

At a recent meeting of the German Congress of Naturalists and Physicians, Dr. Plagge read a memoir on the filtration of water, in which he argued that the essential task of filtration is to free water from infectious matters. As such matter consists chiefly of bacteria, the value of a filter must be judged according to the efficacy in the destruction or removal of the bacteria present in the water. The distinction of the bacteria into pathogenous and non-pathogenous is here unimportant, since a filter which allows the non-pathogenous germs to pass will not keep back those which are pathogenous, while, on the other hand, we are justified in assuming that a filter which keeps back all other bacteria will give protection against infectious matters.

Most of the ordinary domestic filters, and especially those containing as their material spongy iron, carbon, stone, gravel, and cellulose, do not—according to the author's observations—come up to the above requirement. On the contrary, there is generally found a marked increase of organisms in the filtering material. Experiments made with pure cultures of typhus and cholera prove that such filters allow these infectious matters to pass without hindrance. Better results were obtained with clay and asbestos filters of different constructions (Chamberland, Breyer, Olschewsky, Arnold, and Schirmer), as for a certain time they yielded water perfectly free from germs. However, it was not found practicable with any of these apparatus to obtain water perfectly free from microbia. According to Hesse, asbestos strongly compressed, and especially dense cells of clay, form a filtering material which yields water permanently germ free. On this point the author is for the present unable to decide, since these apparatus have not been produced for practice, and he has not been able to procure such.—*Chemiker Zeitung.*

Deer Hunting with Steam.

One morning in October, while running his train over the Delaware division at a high speed, about two miles this side of Parker's Glen (New York), Engineer Merritt Turner saw a handsome buck deer on the track about a quarter of a mile ahead of him. The track at this point runs for miles along the side of the mountain, its precipitous sides being on the south side and the Delaware River on the north, 30 feet below the level of the track. The deer could not climb the mountain, and evidently did not relish the idea of making the 30 foot jump; so it increased its speed, and bounded away down the track ahead of the approaching train. Engineer Turner took in the situation, and, throwing his engine wide open, started after the affrighted animal. It was lungs and wind against steam and axle grease, and the latter won. The deer was overtaken, and the locomotive threw the poor creature with great force against the rocks, fatally injuring it. The trainmen cut the animal's throat, threw the carcass on the pilot of the locomotive, and took it to Port Jervis. The trainmen feasted on venison for a week.

A New Remedy for Asthma.

Pyridine is, according to the *Union Medicale*, valuable as an anti-asthmatic, whether the affection is of cardiac origin or otherwise. About a drachm of the drug is placed on a plate in a small room, to which the patient pays periodical visits, of from twenty to thirty minutes' duration, three times a day. After two or three *seances* the rales in the chest disappear, the expectoration is more free, and sleep is obtained at night, or, at all events, relief from the asthmatic attacks. In some cases the improvement is permanent, in others it only lasts unimpaired for five or six days. Iodine treatment is then required, which is usually efficacious, but which cannot be borne by all patients.

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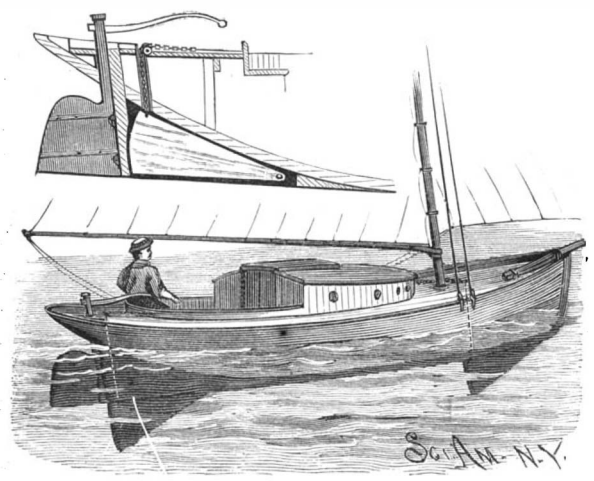
SKEG ATTACHMENT FOR VESSELS.

The skeg is a board of wood or metal of triangular shape, and is pivoted at its forward end in its casing, which is located entirely within the deadwood of the run of the boat. The board is lowered and raised by a rope or chain attached to its after end, and leading up through a pipe, over a sheave in the deck, close to the helmsman.

This attachment is particularly adapted to sail boats navigating shallow waters. By means of this attachment and the board forward, a vessel will fetch where she points in beating to windward in a sea way, since



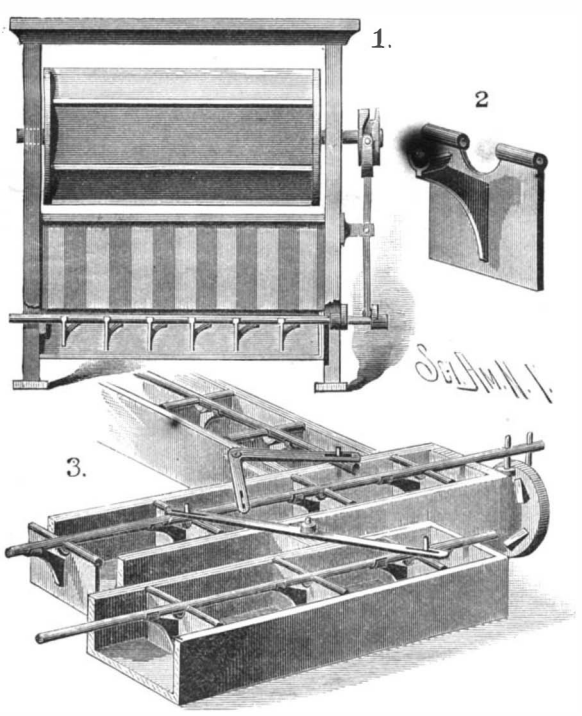
EDMONDSON'S SKEG ATTACHMENT FOR VESSELS.

she has a strong grip in the water both forward and aft, which prevents her from being knocked to leeward by every sea, as is the case with the ordinary centerboard boat. By raising the forward board, she wears around very quickly; and by raising the after (skeg) board, she will immediately shoot up into the wind. By an easy regulation of the two boards, she is made to carry any kind of helm desired, and the rudder is always in line with the keel, except in going about. This last advantage is obvious. The skeg board, being located entirely in the deadwood, takes up no room in the boat, cannot cause a leak, and does not detract from the strength of hull. The increased room thus obtained in the body of the boat makes this attachment particularly applicable to small sized boats.

This invention has been patented by Mr. T. G. Edmondson, of Tarpon Springs, Fla.

IMPROVED GRAIN CONVEYER.

Beneath the bolting chest is a hopper for carrying the product to the conveyer box. To the shaft of the bolt is keyed a cam of suitable diameter to effect one or more strokes of a lever at each revolution of the shaft. The lever is fulcrumed to an offset which may be adjusted to regulate the stroke. The conveyer shaft is held in bearings formed centrally in the ends of the conveyer box, and is given a recip-



HENDERSON & CONGER'S IMPROVED GRAIN CONVEYER.

rocating motion by the lower end of the lever, as shown in Fig. 1, which shows the conveyer applied to the bolting chest. A series of flights are suspended from the shaft at equal distances apart. These flights are formed with a central recess in the top to receive the shaft, and their top edges are bent over to form hinges to receive a pin that passes through holes in the shaft. Attached to the back of each flight is a bracket, Fig. 2, provided upon its extended end with a U-shaped stop, which bears up against the shaft and holds the flight in a rigid vertical position during the forward movement of the shaft. As the shaft returns, the flights assume a slanting position toward the front end of the box, thus permitting their ready passage over the surplus product therein. As the shaft is again carried forward, the product within the box, coming in contact with the face of the flights, engages the stops upon their backs with the shaft, and they again assume a vertical position and carry the product before them. These hinged flights do not crush or grind the stock and, therefore, do not cause any dust. This conveyer occupies but a small space and requires but a small amount of power to operate it, while it may be driven from any point on the shaft where it is most convenient. One or more conveyers may be driven at an angle, or parallel with each other, or both, the power being applied to but one shaft. The arrangement of the levers by means of which one shaft communicates its motion to another, placed parallel with or at an angle to it, is clearly shown in the engraving, Fig. 3. The shaft may be reciprocated by a pulley provided on each side with wedge-shaped blocks which alternately engage pins projecting from the shaft, the pulley being turned by a suitably arranged belt.

This invention has been patented by Messrs. G. W. Henderson and J. C. Conger, of Columbia, Mo.

New York Groceries.

"That is not coffee," said the reporter.

"Who said it was?" replied the jolly, rosy cheeked grocer. "Are there any marks on it to indicate that it is coffee?"

"No, not particularly; but it certainly looks like coffee, and tastes entirely different."

"Ah, you have hit the nail on the head," continued the grocer, with a smile. "It would not do to let every one know it, as it might shake people's confidence in their grocery store. The bag, a few beans from which you have just tasted, contains an imitation of coffee. It is nothing more than flour, and poor flour at that, which has been shaped like the coffee bean and baked brown. If you will take a genuine coffee bean in your hand and put it alongside the imitation, you can see that there is a difference in the color. The shape is also different, but that is nothing, as the various kinds of coffee vary in shape and size. The flavor, of course, is not there, but the way the imitation is sold does not require its presence. The grocer is not a foolish man. He does not sell these flour beans for coffee. This would give the business away. But when trade is dull, and the grocer must have something to occupy his mind, it is a pleasant recreation for him to mix a quantity of the flour beans with the genuine coffee. Then it cannot be easily detected. Only just enough of the flavorless bean is used to make a little profit. This is not quite one-half. When the honest housewife who buys whole coffee so as to get it pure grinds up this mixture, and the odor steals out from the mill, her eyes snap, and she laughs at the people who are foolish enough to buy the coffee which is ground at the store, and can be easily adulterated. The taste of this compound is not unpleasant, and it will not injure any one. Even the baby can take it with impunity. If the coffee were drunk plain its weakness would be noticeable, but being usually taken with milk and sugar, the fraud is not detected. Years ago all the coffee was ground in the grocery, but adulteration was carried on so extensively that the practice was established of buying the whole bean. This led some inventive Yankee humanitarian, who believed that too much coffee is bad for the nerves, to bring out the flour bean.*

"Here is something else interesting. See these beautiful samples of cloves and peppers. Imported? Well, no, not exactly. They are home-made to suit the trade. They look good, but there is little flavor to them. Some one thought it was a shame to waste the beautiful and nourishing cocoanut shell, and conceived the idea of heating it and then grinding it to a fine powder. This, when artistically mixed with various kinds of oils, makes a good spice for pies and other good things. It is a growing industry, and well patronized. Some of this powdered shell, after being flavored and made into a stiff paste, is pressed through moulds into the shape of peppers and cloves. These, mixed with a quantity of the genuine article, give about all the flavor that it is safe for a person to take, and the grocer does not lose anything, but goes on paying his pew rent and building rows of houses the same as if there were a little cream in the cheese, a small quantity of sugar in the glucose, and a taint of butter in the oleomargarine."—*N. Y. Tribune.*

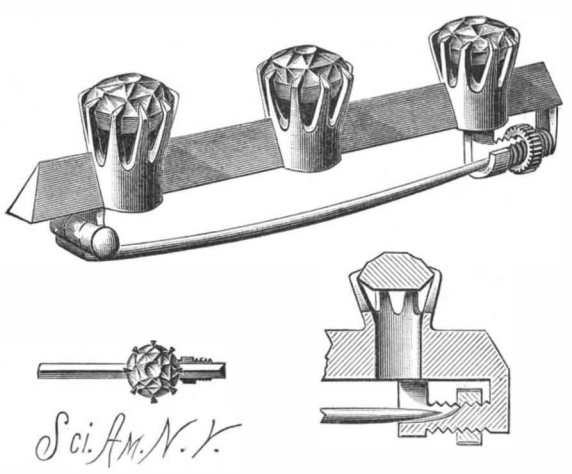
Diphtheria and Manure Heaps.

M. Ferraud, *Lyon Medical*, traces the relation between manure heaps and rural epidemics of diphtheria. On one occasion the disease appeared the day following a general street cleaning. He argues that manure should be kept in closed wells of stone, glazed with bitumen, so constructed that the fluids filter away from the solid matter.

* Notwithstanding frequent denials, the *American Analyst* positively states that it has seen these imitation coffee beans.

SAFETY FASTENING FOR LACE PINS, ETC.

This simple fastening, which may be applied to lace pins, brooches, and hair ornaments, is so constructed that the pin is not liable to become accidentally unfastened. The free end of the pin, which is hinged to the body in the usual way, enters a recess in the upper side of a socket attached to the body, as clearly shown in the engraving. The exterior of the socket is screw-threaded, to receive a milled nut. After the point of the pin has been placed in the socket, the nut is screwed toward the pin, so as to cover the recess, and thereby most effectually prevent the removal of the pin. The turning of the screw in the opposite direction uncovers



COOPER'S SAFETY FASTENING FOR LACE PINS, ETC.

the recess and allows the point of the pin to be removed.

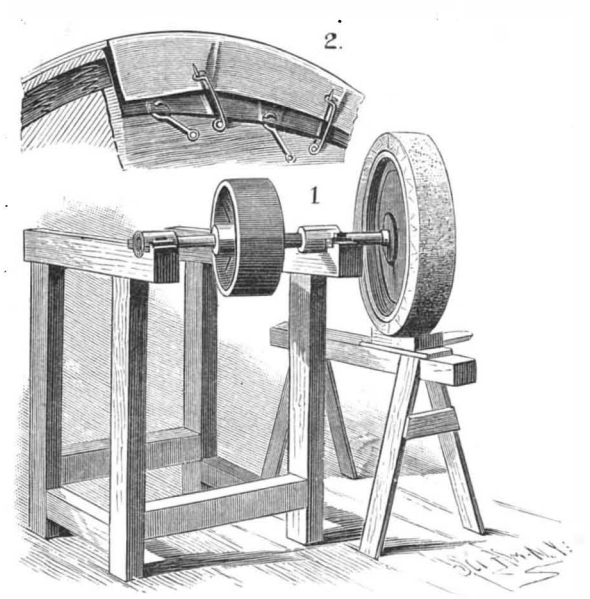
This invention has been patented by Mr. C. A. Cooper, of 5 Union Square, New York city.

Supplementary Rudders.

In narrow canals, where the depth of the water does not considerably exceed the depth of immersion of the vessel, it becomes a matter of difficulty to steer large ships, and damage has, in consequence, repeatedly resulted in the Suez Canal. To overcome this difficulty, it has been proposed to increase the surface area of rudders, and for this purpose Decerfz has introduced a supplementary rudder, which consists of an additional piece attached to the rear part of the rudder by means of iron hoops and bolts. The supplementary rudder is attached before the vessel enters the canal, and removed upon leaving the canal. The vessels of the Peninsular and Oriental Company have employed this supplementary rudder with considerable success.

SANDPAPERING AND POLISHING MACHINE.

The accompanying engraving illustrates a sandpapering and polishing machine, which is the invention of Mr. T. B. Marshall, of Sidney, Ohio. With this machine either a flat, oval, or concave surface can be sandpapered and polished with the grain of the wood. To the peripheral face of the wheel, which is of any suitable size, say 24 inches, are secured springs shaped as shown in Fig. 2, and placed as close together as possible. A band of felt is placed about the springs and held in position by a strip of sacking or canvas, the



MARSHALL'S SANDPAPERING AND POLISHING MACHINE.

edges of which are corded. This strip is held in place and prevented from creeping by hooks secured to the side of the wheel by nails. The sandpaper is applied so as to rest smoothly upon the peripheral surface of the wheel, the edges being bent over and crimped and secured to the sacking by safety pins. The wheel is mounted upon a shaft driven in any convenient way. The work to be smoothed and polished is pressed against the surface of the rapidly revolving wheel. This machine has been practically tested, and has given most satisfactory results.

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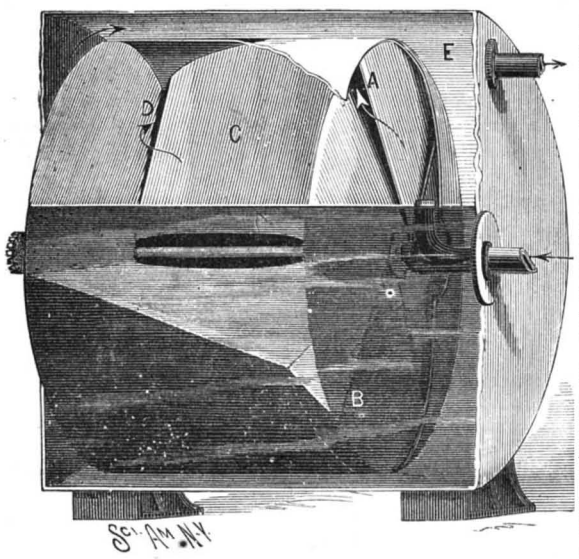
THE GREAT GAS METER OF THE CONSOLIDATED GAS CO.

(*Continued from first page.*)

pass through it. As it forces its way in, it causes the meter to rotate. This gradually carries the inlet hood around until it is immersed in water. No more gas can enter the compartment; in other words, it is full of gas. But just as this immersion occurs, the outlet hood comes out of the water, thus giving the gas a way to escape from the drum. As the drum rotates, the gas is forced out, and the next division fills. In each rotation the four divisions are successively filled and emptied. Each one is an Archimedes screw, beginning and

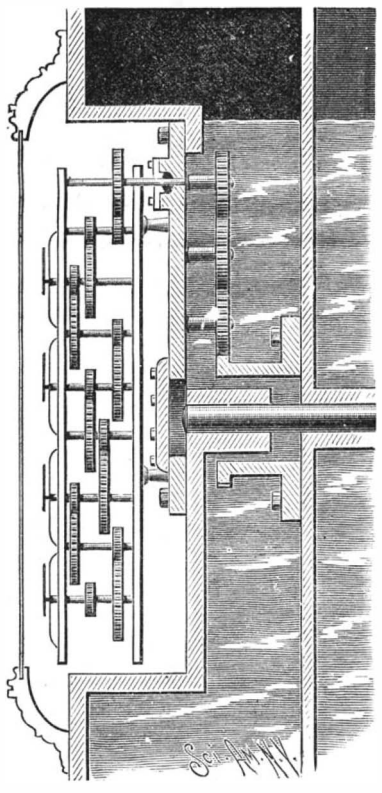


METER DRUM.

ending in about the same plane, but on opposite sides of the axis and opposite ends of the drums.

The water level, it will be seen, determines the capacity of the drum. Hence it must be preserved constant. This constancy in the meter we are describing is secured by an overflow. Water is continually running in and out of the meter through an overflow pipe of proper height.

It is also necessary to force the gas to go through the drum, and not around it. The rear end of the cylinder of the drum is carried out a short distance, and closed with a plate, solid except for a hole in its center. This hole is completely immersed in the water. The inlet pipe runs through this hole under the water and curves up into the space above the water. Thus the gas cannot go around the drum. The cap is shown partly in section in the small drawing, half being broken away. Referring to the drawing, the top of the drum is moving toward the spectator. The gas is entering by the curved pipe in the center of the back of the case. It is carried within the cap, the pipe



INDEX TRAIN.

passing through the immersed aperture in its center. The compartment marked C has just filled with gas. The opening of its inlet hood at B has gone below the water, so that no more gas can enter it, while its contents is escaping through the aperture of the outlet hood at D into the case, E, and thence by the outlet pipe into the main. Meanwhile gas is entering at A into the compartment next to and beyond C, and is turning the drum. The course of the gas is indicated by the arrows.

In the next cut is shown the arrangement of the index train. A gear wheel is carried by the drum. Its motion, by a train of idle wheels, is carried above the water line, where a spindle attached to a working gear wheel passes through a stuffing box in a recess in the front head of the meter. Hence the motion is carried through the long train of wheels, each successive one rotating at one-tenth the rate of its predecessor. Thus if one index rotates once around its dial for 1,000 cubic feet, the next one is reduced to one-tenth that speed, so that one rotation of this next index indicates 10,000 cubic feet. Each dial is divided into tenths of a rotation, so that the first dial mentioned above would be divided into successive hundreds of cubic feet.

The meter was erected by the American Meter Company, of this city, to whom belongs the honor of being the makers of the largest meter in the world. The iron work and casting of the case were executed at the Continental Iron Works of Brooklyn, N. Y.

Important Electrical Patent Decision.

An important decision was not long ago rendered in the Chancery Division of the High Court of Justice, London, before Mr. Justice North, in the suit of Abraham Van Winkle, of Newark, N. J., U. S. A., *vs.* William Alexander Carlyle, of Birmingham, England. This was a suit for infringement of dynamo-electric machines for electro plating, owned by the said Van Winkle, of the firm of Hanson, Van Winkle & Co., Newark, N. J., and has been some time pending in the English courts. An interim decree for injunction having previously been granted, it has now been made absolute—the defendant being restrained during the continuance of the letters patent or any extension thereof from making or selling any magneto-electric machines under or in accordance with or in violation of the letters patent on which the suit was brought.

The firm of Hanson, Van Winkle & Co. were the first introducers of dynamo-electric machines in this country, and the above decision is likely to have considerable influence on the sale of their new machines, both here and abroad, as this is considered a test suit.

The invention relates to the radial construction of the armature and the use of a governor to prevent reversal of the current.

THE CAPILLARY SIPHON—HERO'S ENGINE.

T. O'CONOR SLOANE, PH.D.

In the last article of this series we described some experiments with capillary siphons, emphasizing the fact that capillary force ceases to operate as soon as they become fully charged with water. A simple experiment appears in the cut, showing how a boat could be sunk by a siphon of this description. It is conceivable that a sail hanging over the side of an open boat into the water, its inner end reaching to the bottom of the boat, might fill it. The sail would first become charged with water by capillary action, and then, acting as a siphon, would draw water over the sides and into the interior.

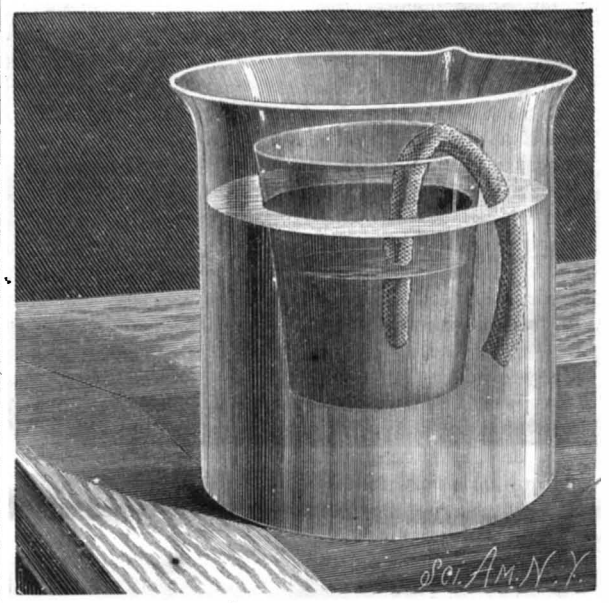
For the experiment, two vessels are needed. They are preferably of glass. One must be large enough to contain the other, with some space to spare. The large vessel is filled with water. The small one is floated in it. If the latter tends to cant to one side, a few bits of lead, or coins, or even sand, may be introduced as ballast. Thus arranged, the bottom of the inner vessel will be one or two inches below the level of the water outside of it. A lamp wick, or strip of muslin, preferably well soaked with water, is next placed in the position shown, care being taken to have the inner end reach well down toward or touching the bottom. The siphon action begins very soon, and water gradually collects in the floating vessel. This does not interfere with the siphonage by raising the level of the contained fluid, because very nearly as fast as it rises the vessel sinks. Thus the difference of level is maintained almost constant, except for the slight floatative effect of the additional portion of the glass submerged. The operation continues until the edge of the glass becomes even with the surface of the water on which it floats. The water suddenly rushes in and the glass sinks.

If a good quantity of muslin is used, the glass will sink in a few minutes. By the use of a lamp wick the operation will be somewhat prolonged.

The point made about the approximate constancy of the difference of internal and external level is an interesting feature of the experiment. It recalls the old problem about the level of water in a vessel in which a lump of ice is floating. The question is, how the level is affected by the melting of the ice. Assuming the temperature of water and ice to be about 32° F., the level will, of course, remain constant while the ice floats in it and after it is melted.

In the other illustration is shown a simple way of constructing a reactionary steam engine. It is on the principle used in the Barker's mill, already described in this paper. Steam is generated and driven out of an aperture. It necessarily pushes backward the tube from which it issues, and the tube is so arranged as by this backward motion to cause a central body to rotate around a fixed axis.

A round bottom flask, of about 150 cubic centimeters capacity, is a convenient one for the boiler of this primitive steam engine. It is fitted with a perforated cork and to the cork a tube is adapted, bent into the form shown in the cut. Its end is slightly drawn out, forming a large jet. The flask is half filled with water. A circular piece of wood, about six inches in diameter and an inch thick, is provided, through whose center a hole is made. This hole must be large enough to admit the neck of the flask freely, so that the board will rest firmly upon its shoulders. The hole may with advantage be chamfered or countersunk on one side to fit. A round bottom flask is recommended, because it will stand direct contact of flame when it contains water.



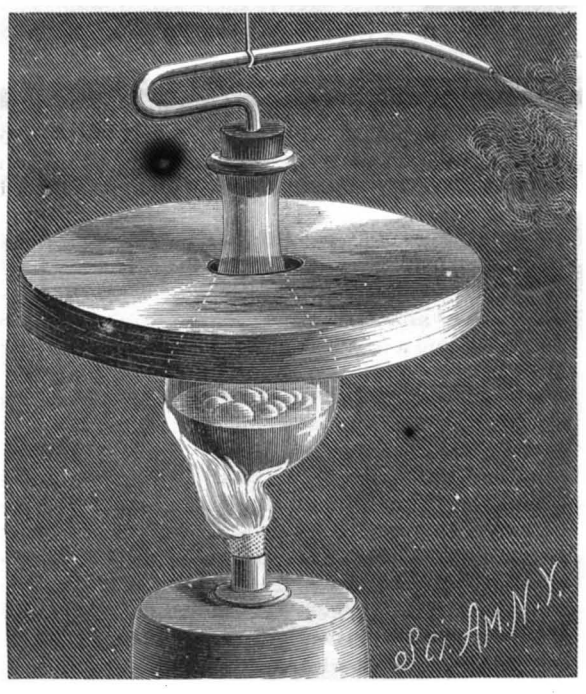
CAPILLARY SIPHON.

The cork, after the flask has been passed through the aperture in the board, is put in position in its neck, and the whole is suspended by a silk thread, which should be as long as possible. An alcohol lamp is placed under the flask and is lighted.

In a short time the water begins to boil. A few drops of water are first projected from the end of the bent tube, after which steam begins to issue. As the jet of steam acquires strength, its reaction becomes perceptible, and the tube is driven backward by it, imparting a movement of rotation to the suspended apparatus. The velocity increases until the bottle and board whirl around at high speed.

The circular board here comes into play in preserving, by its gyroscopic force, the steadiness of rotation of the apparatus. It retains the flask in position over the lamp flame. Without the board, the apparatus oscillates from side to side and cannot be well heated.

For a suspension cord a silk thread a couple of yards long may be used. A thread a foot long answers perfectly, but as the flask rotates, it becomes soon twisted or untwisted, and breaks; but a long thread will admit of several minutes' running before giving away. Owing to the small power of the reaction, it is not easy



HERO'S ENGINE.

to find an available swivel. The friction interferes with the speed.

It might be supposed that the board would be burned. But if the flame is made to impinge directly on the glass, the board will not feel its effects seriously. It will not, of course, be heated except for a few minutes at one time, and this will have little effect upon it. The experiment in connection with the Barker's mill is a good illustration of the identity of some laws affecting liquids and gases. It shows that both alike possess mass, and by their reaction, if caused to move, can generate absolute force due to mass moved.

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Correspondence.

Railway Improvements Needed.

To the Editor of the Scientific American:

The recent terrible railway accident on the line of the C., M. & St. P. Ry. Co., near Rio, Wis., sends a shudder through the entire country, and again, as after each previous disaster of this kind, the question arises, Is there no way to prevent these dangers to which every traveler is liable?

As a step in the direction of greater safety, there are two things which must be accomplished:

1st. Some means must be found to stop trains even more quickly than by the use of air brakes. This can probably be accomplished by an increase of friction, and it is for our inventors to say how this increased friction may be gained. By way of suggestion, I would ask if boxes of sand cannot be placed near each set of wheels; the same to be controlled from the engine. I believe that by means of the air brakes the sliding of the wheels is possible; if not, it might be made so. The presence of sand on the rails would then add materially to the friction.

2d. In order to do away with the horrors of a burning wreck, other methods than those now employed must be found for heating and lighting passenger cars. They might be lighted by the use of electricity, though that is not of so much importance as the matter of heating.

It has been demonstrated only too often that fire cannot be safely carried in passenger coaches, and it is impracticable, in this northern country, to attempt to heat the cars by steam from the engine. There is one method, however, which I think might be employed, viz., the use of soda. It is a well known fact, though of recent discovery, that soda when charged with steam is a source of great heat. Cannot this knowledge be practically applied for heating purposes? I should think that metallic cases of soda might be arranged in a car, and, being charged from the engine, heat the car either by radiation or, perhaps better, by the generation of steam in suitably arranged boilers. In the latter case, the steam, after passing around the car through pipes, could be discharged into the soda, and thus a recharge from the engine be required less frequently.

FRANK HAYES.

Minneapolis, Minn., Nov. 15, 1886.

Paris Cement.

A new cement, called "cement de Paris," has been introduced in France, the inventor and manufacturer of which is M. Vallin, the director of a French cement works, the Gypserie de la Gare. The new material is stated to be at least equal, if not superior, in quality to the English article, while it can be sold at the rate of 2s. 6d. to 5s. per cwt. This material is said to possess durability and the cold appearance of marble, and a wall rendered, floated, and set with it becomes impermeable to moisture. It can also be polished, and made to present an elegant appearance. In the usual method of manufacturing cement, it is generally found very difficult to obtain a thorough burning of every piece of clay or stone; sometimes the surface of it is burnt too much and the center too little or not at all. The result is that, after the clay or stone is crushed, it contains a considerable quantity of unburnt grains, which play the role of an inert material, and which people pay for as cement. In order to avoid this unequal burning, M. Vallin, instead of crushing the material after, does so before placing it in the kiln. A crushing mill breaks it into small pieces, which are automatically conveyed to a vertical cylinder mill, whence they issue ground to powder. This is in turn again automatically placed on sieves, which shift it into pans or kilns heated by gas. A series of inclined plates, having a gyratory motion, agitate the powder in each of the pans, and thus render every particle of it amenable to the action of heat. Finally, a mechanical arrangement conveys it to sacks, which a man fills as the powder arrives. The whole operation is thus continuous and automatic, which of itself is a great advantage. But still more important and appreciable is the fact that all the particles of the cement are thoroughly burnt. M. Vallin estimates that his method enables him to effect a saving of about 30 per cent over those ordinarily adopted. Besides the homogeneity of the particles, the other advantages claimed for this cement are its great whiteness of color, durability, and freedom from liability to unequal shrinkage, which causes fire cracks.

The New Water Tunnel, Chicago.

The work on the new lake tunnel at Chicago is progressing rapidly. The men work in three shifts, of eight hours each. The first dig the hole about 10 ft. in diameter, through clay, at the rate of about 18 ft. per day, the second trim it up and wall with planks, and the third lay a circular wall of bricks in cement, 12 in. thick. The tunnel is left a shade over 7 ft. in diameter, the whole plastered with cement. This will be completed in about five weeks, and the whole work in about three months.

Geologic Distribution of Natural Gas.*

Although natural gas springs are to be found in almost every State in the Union, and in many States gas has been obtained in wells sunk either for water, oil, gas, or as solid mineral prospecting holes, yet the occurrence of natural gas is not dependent upon mere chance, as is popularly supposed, but is, as is now beginning to be recognized by both professional and practical men, a result of special geological phenomena.

The desire among our leading manufacturers to emulate Pittsburg has led to the sinking of many wells in many localities in search of natural gas; some of these wells being located and drilled under the direction of professional experts, but many more being located by persons who are ignorant of the conditions under which gas has already been found, and by "quack" explorers, who often depend upon spiritualistic communications or the divining rod.

The literature on the subject of the geographical occurrence of gas, except in areas contiguous to the Pennsylvania oil regions, is very meager, and scarcely anything has been published on the geology of natural gas except that contained in the reports of the Pennsylvania Survey, of which Mr. Carll has been the leading author. In considering the geologic distribution of gas in the United States, I have not sufficient facts at present in my possession to make a paper on the subject complete or exhaustive.

The practical application of natural gas, in various forms, in Western Pennsylvania has opened up a new era in fuel economy and the development of heat and mechanical power, and it becomes a practical necessity for every community where there is the slightest possibility of finding natural gas to make a thorough and intelligent exploration for it; and for all other communities, in which, from the geological conditions of the underground structure of their region, it is impossible for the rocks to contain gas in commercial quantities, to plan to manufacture a fuel gas. There is no doubt in my mind but that the greatest advance to be made in the practical arts and sciences during the next two decades is to result from a practical consideration of the question of the manufacture and utilization of gaseous fuels, and the adaptation of plant and machinery to the new fuel relations that I believe we are bound for economy's sake to establish.

It is difficult to prescribe any fixed limits in the geological scale to the occurrence of natural gas and petroleum. Every known rock, with the exception of the eruptive rocks, is known to contain the remains of organic matter (vegetable and animal); and since the leading geologists agree in the opinion that both oil and gas result from the decomposition of organic remains, it is quite possible to find gas and oil in rocks of any geological age—in some rocks in commercial quantities, and in other rocks in quantities so small as to be only of scientific interest to the geologist and mineralogist.

Next to the necessity of having a sedimentary rock in which animal or vegetable remains of past geological ages have been buried, the presence of gas is dependent upon the existence of a porous or cavernous rock, to serve as a reservoir to hold the gas, and an overlying impervious rock roof to confine the gas. The other necessary conditions for the occurrence of gas are more dependent upon the forces to which the strata have been subjected, and the resulting geological structure, than upon the age of the rocks themselves.

The tendency among practical oil and gas well drillers and operators to discover, in a new district where a well may be drilled, the same section of rocks as is found in an old district makes it important that both drillers and operators should realize the fact, as proved by geological investigation, that no two wells can be put down, distant from one another but five miles, more or less, where the same section of rocks may be found in both wells.

All the oil and gas horizons in Pennsylvania are located in sandstones and shales, from the Portage up to and including the Coal Measures. In Ohio, the oil and gas horizons are included in the Paleozoic strata from the Upper Coal Measures down into the Trenton Limestone. In New York, where natural gas is more generally distributed, as indicated by gas springs, than in either Pennsylvania or Ohio, but where much less has been found in commercial quantities, the gas horizons are found in the formations from the Chemung down to the Hudson River Shales, inclusive, with the possibility that some may be found in the Trenton Limestone.

On account of the intimate connection existing between oil and gas, it is reasonable to suspect the existence of natural gas in all sandstones producing oil.

The amount of gas that is at present flowing from the explored sands in Pennsylvania is probably two or three times greater than is required to meet all present demands. With an appreciation of this fact, and of the possibility of extending the gas pools and developing new ones, very little alarm should be entertained as to the exhaustion of the gas sands of Pennsylvania and the prostration of the manufacturing interests that become dependent upon its use. It becomes, however, a question of vital importance to the commonwealth of Pennsylvania, and to every citizen interested in the industrial concerns of the State, that the extravagant waste of gas that is now going on everywhere throughout the oil and gas region should be stopped. The action of the Philadelphia Company, which is now one of the largest natural gas companies in Pennsylvania, in shutting in the wells all the surplus gas that is not needed, should be emulated by every individual who has pecuniary interests in gas wells; and it is a question that should be settled by our State Legislature, by compelling all gas well drillers and operators to shut in the gas that is not needed.

The discovery of natural gas in Ohio is the dawn of a most important era to the manufacturing and industrial interests of that State. This statement is worthy of special reference here. Any comparison as to the amount of gas that Pennsylvania and Ohio respectively will be able to produce in the future would be invidious, and in fact we have not sufficient evidence upon which to base any reliable conclusion. That there is sufficient gas in Ohio, as well as in Pennsylvania, to meet the demands of manufacturers for a number of years, and sufficient in many localities to warrant the erection of new plants, there is no doubt; but still it is well to bear in mind that our gas supply is exhaustible, and that in the main all the gas that we can hope to obtain in the future now exists in a gaseous form confined in our rock reservoirs. When these reservoirs are emptied, our supply will have ceased.

* Abstract from the *Engineering and Mining Journal* of a paper read at the St. Louis Meeting of the American Institute of Mining Engineers, last October, by Charles A. Ashburner, Geologist in charge Pennsylvania Survey.

DECISIONS RELATING TO PATENTS.

U. S. Circuit Court.—Northern District of Illinois.

POPE MANUFACTURING COMPANY *v.* OWSLEY. OWSLEY *v.* POPE MANUFACTURING COMPANY.

INTERPRETATION OF LICENSES.

Blodgett, J.

Equity has jurisdiction to compel a discovery of the number of patented articles made under a license, where the licensee neglects or refuses to make monthly reports as he has covenanted to do, and a covenant to make a monthly report is, in fact, a covenant for a monthly discovery of the work done under the license.

Where a license does not purport to give an unlimited right to the use of the patent, but restricts the right to machines of certain descriptions, when licensee makes machines not in conformity to his license, but within the patent, he not only violates his express covenant not to do so, but violates the patents.

A license provided that licenser may terminate it by notice in writing. He sent a postal card to licensees, reading: "Your royalty return for February has not come to hand. Failure to forward same within five days from March 10 subjects your license to revokement." *Held*, that this paper fell far short of a notice in writing of a revocation or termination of the license.

Licensees under patents covenanted that they would not dispute or contest the validity of the same or of complainant's title thereto. *Held*, that as long as the licenses remain in force defendants are estopped by the terms of their agreements from denying the validity of the patents in question.

The mere fact that the owner of a patent alleges an infringement, and threatens suit unless a settlement is made with him, cannot be held to make such settlement void for fraud or intimidation.

The fact that defendants feared the result upon their business of a suit for infringement of patents, and therefore settled and took a license, is no support to a charge of fraud in the procurement of the license.

Where a license was granted covering a large number of patents, including one which had already expired, but which licenser owned and licensee had infringed, and there was no proof that it was included by the licenser in bad faith, *held* not enough to taint the transaction as fraudulent.

The date or duration of a patent is a matter of public record, of which a licensee is as much bound to take notice as the licenser.

A license under patents is not affected by the fact that in a suit between other parties the patents have been adjudged void where the licensee has agreed not to contest their validity.

Where licensee under a patent agrees not to contest its validity nor licenser's title, he cannot urge want of patentability nor any question save that whether his devices are covered by it.

Where the alternative to settle a claim for infringement or litigate is fairly tendered to a party and he chooses to settle, he cannot afterward retreat from the settlement merely because some other party has successfully contested the validity of the patents.

Where a license included a large number of patents, and provided that licensees should pay a stipulated royalty on all machines made by them "embodying in their construction or mode of operation the inventions and improvements shown and described in each, all, or either of said letters patent," *held* that so long as licensees used either of the patents they were liable to pay the royalty named in the license.

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DEPREZ'S GALVANOMETER.

BY GEO. M. HOPKINS.

To rivet scientific facts in the mind, study and practice must proceed together. This is especially true in electricity, where a multitude of conditions are imposed for every phase of the subject.

No one can go very deeply in the study of electricity without reaching the subject of electrical measurements; certainly very little can be done in this direction without a galvanometer of some kind. Among all the galvanometers yet invented, there is perhaps none possessing all the good qualities of the one shown in the annexed engraving. It is very simple; the materials are inexpensive, no great mechanical skill is required in its construction; and its sensitiveness and accuracy are sufficient for the requirements of most electricians. Besides all this, it is perfectly "dead beat," so that no time need be wasted in waiting for the instrument to come to rest.

This galvanometer is the invention of M. Deprez, of Paris, France. It consists essentially of a rectangular coil of fine wire, suspended on strained torsional wires in a strong magnetic field.

To the base is secured, by means of angle plates, a compound U-magnet, 7 inches high, formed of three steel magnets, one-quarter inch thick, secured together and to the angle plates by bolts. The distance between the inner faces of the poles of the magnet is $1\frac{7}{16}$ inches. Two and three-quarter inches behind the center of the magnet a brass column rises from the base, and is provided near its center with an adjustable brass arm, supporting at its outer end, and exactly in the center of the space between the poles of the magnet, a hollow soft iron cylinder, $2\frac{1}{4}$ inches long, $1\frac{1}{32}$ inches in external diameter, $\frac{13}{16}$ inch in internal diameter. The top of this cylinder is even with the upper ends of the magnet. To the top of the brass column is secured, at right angles, an arm that extends over the hollow iron cylinder, and is provided with a vertical sleeve, in which is clamped a rod having on its lower end a small silver hook, arranged axially in line with the iron cylinder.

To a block attached to the base, opposite the center of the magnet, is secured a tapering spring, $\frac{1}{16}$ inch thick and $3\frac{3}{4}$ inches long, carrying at its free end a small silver hook, which is arranged in line with the axis of the iron cylinder.

A rectangular coil of No. 40 silk-covered copper wire, large enough to swing freely over the iron cylinder, is suspended by a hard-drawn No. 32 (0·008 inch in diameter) silver wire from the hook above, and is connected by a similar wire with the hook on the spring below. The upper wire is $2\frac{1}{4}$ inches long between its connections, the lower one $2\frac{3}{4}$ inches.

The sides of the rectangular coil are flat, being about $\frac{1}{8}$ inch thick and $\frac{5}{16}$ inch wide. The resistance of the coil is 150 ohms. The silver hooks are connected with opposite ends of the coil, in the manner shown in Figs. 4 and 5. Each hook is provided with a flat head, which is secured between two thick plates of mica, the shank of the hook projecting through a hole in the outer mica plate. Each pair of mica plates is secured in place on the coil by a winding of silk, which is coated with shellac varnish to prevent the plates from slipping. The hooks are arranged exactly in the middle of the ends of the coil, so that when the coil is supported in the position of use by the silver wires it will oscillate freely between the poles of the magnet and the iron cylinder. The terminals of the coil are soldered to the silver hooks. The upper hook is made a little more than a half inch long, to receive a small concave mirror (as shown in Fig. 4), which is secured in place by cement or wax. The mirror has a focus of 30 or 36 inches.

The relation of the magnet, A, the coil, C, and the iron cylinder, B, are clearly shown in Fig. 3, which is a horizontal section taken through those parts.

A glass shade protects the delicate parts of the instrument. The two binding posts which are outside of the glass shade are connected under the base with the brass column and the spring, so that the current passes from one binding post to the column, thence down the upper silver wire, then through the coil, the lower silver wire, and the spring to the other binding post.

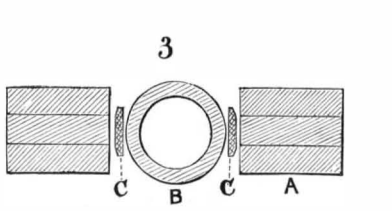
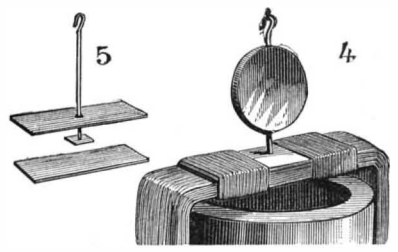


Fig. 3.—HORIZONTAL SECTION OF MAGNET, COIL, AND CORE.



FIGS. 4 and 5.—DETAILS OF DEPREZ'S GALVANOMETER.

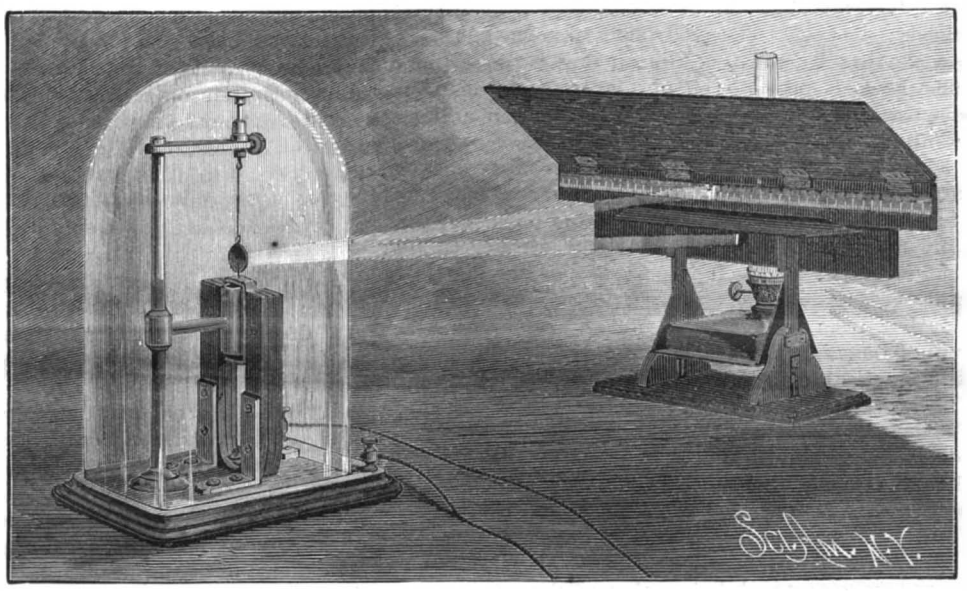


Fig. 2.—ARRANGEMENT OF GALVANOMETER AND SCALE.

The silver wires are placed under considerable tension, and the coil is adjusted to a central position by turning the hooked rod at the top of the instrument.

When an electrical current is sent through the coil, it tends to assume a position at right angles with a line joining the two poles of the magnet, the amount of displacement of the coil from its normal position depending on the strength of the current. As the deflection for a very light current is small, a beam of light reflected from the concave mirror is employed as an index. The scale is arranged as shown in Fig. 2, the light being projected from a lamp, supported at the proper height behind the scale, through a slit below the scale and on to the concave mirror. The mirror reflects the beam on to the scale. The mark at the center of the scale is 0, and arbitrary numbers, running upward regularly, are arranged on the marks on opposite sides of 0. The common paper scale used by draughtsmen answers for this purpose.

When the coil is at rest, the light spot remains at the center of the scale; but when a current passes through the coil, the beam moves steadily forward and stops without oscillation, the distance through which it moves depending of course, on the strength of the current. The coil is returned to its normal position by the spring of the silver wires.

By employing shunts in the usual way, heavy currents may be measured by the aid of this instrument. The sensitiveness of the instrument is so great as to indicate a current when the ends of two No. 18 copper wires connected with it are placed on opposite sides of the tongue.

The coil is carefully wound over a form covered with paper, each layer of wire being varnished with shellac varnish as the work of winding progresses. When the coil is complete, the coil, together with the form, is heated in a warm oven until its varnish becomes hard throughout the coil.

The concave mirror may be purchased from the optician, or a very fair mirror may be made by cutting a small disk from a double convex spectacle lens of 60 or 70 inch focus, and silvering it. A simple and quick way of silvering a small surface consists in scraping from the back of a piece of ordinary looking glass all of the silvering, except a patch of the size of the mirror to be silvered. A small drop of mercury placed on the patch soon loosens it, so that it may be slid from the glass and transferred to the disk. The disk must be perfectly clean. After the patch is in position on the disk a piece of tin foil is placed on the back of the disk, pressed down firmly, and allowed to remain long enough to absorb all of the surplus mercury. It is then removed, and the transferred silver will be found adhering strongly to the disk.

The various dimensions above given are taken from an almost exact copy of a Deprez galvanometer made by Carpentier, of Paris. The copy operates admirably.

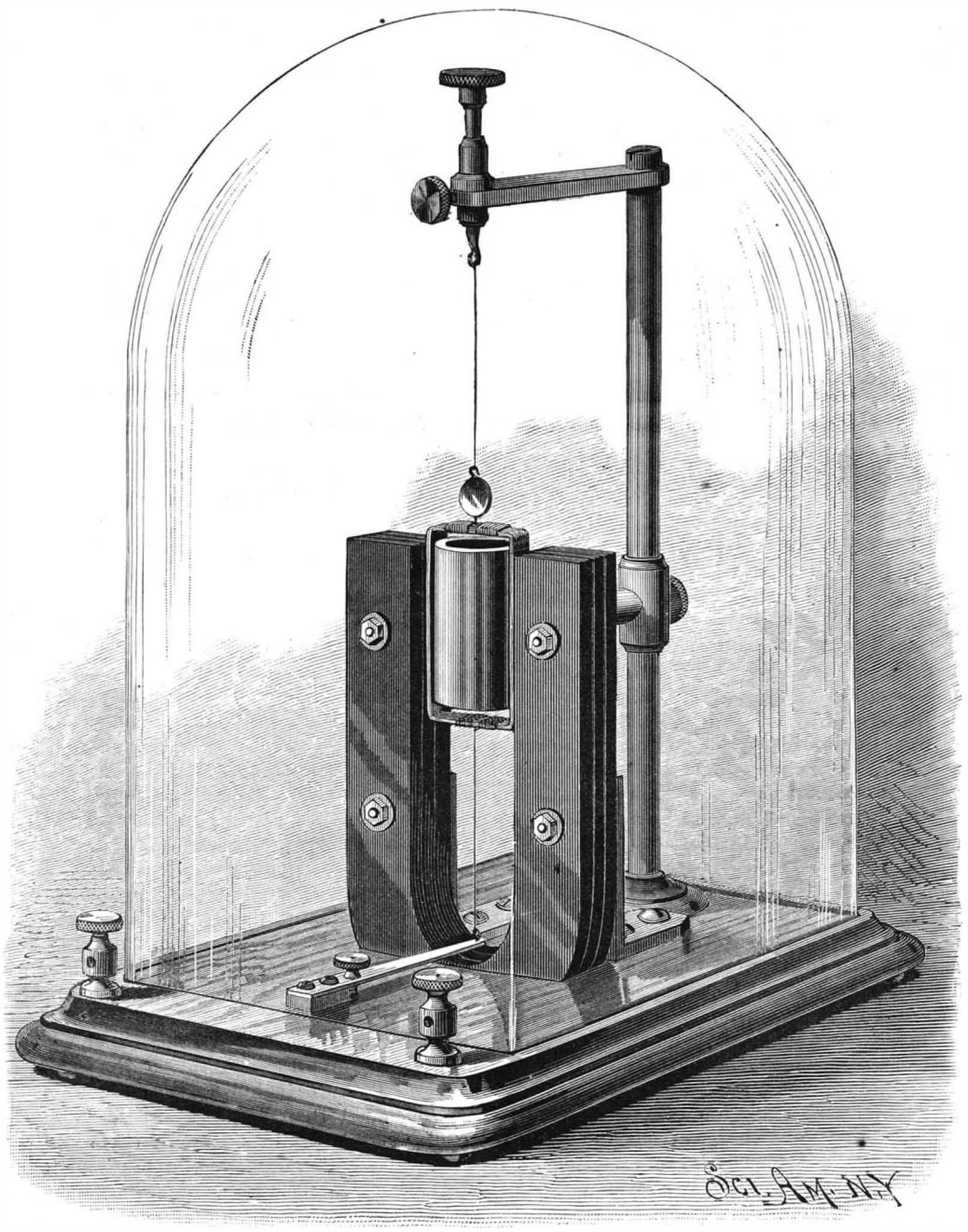


Fig. 1.—M. DEPREZ'S "DEAD BEAT" GALVANOMETER.

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It is probable, however, that a considerable deviation from these dimensions might be made without seriously affecting the value of the instrument.

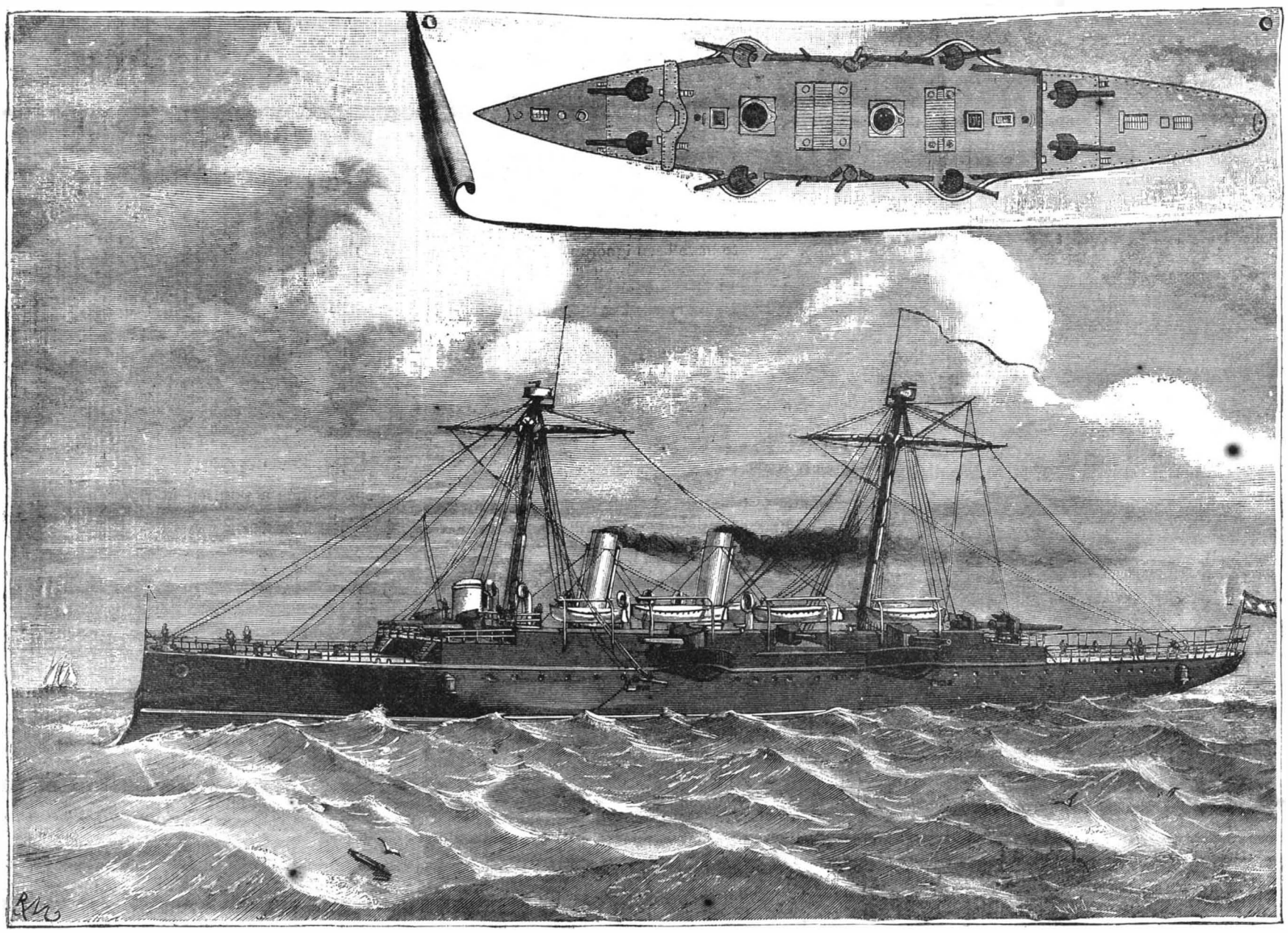
THE NEW SPANISH WAR STEAMER REINA REGENTE.

Another magnificent vessel has been added to the Spanish navy, being a cruiser of the first class, Reina Regente, constructed on the Clyde, under the direction of the Spanish Minister of the Marine, by Messrs. James & George Thompson, naval constructors.

The principal dimensions of the Reina Regente are as follows: Extreme length, 335 ft.; extreme width, 50 ft. 7 in.; depth, 32 ft. 6 in.; normal draught, 20 ft.; when loaded, 26 ft.; normal displacement, 4,800 tons. She has two screws, and triple expansion engines, which give 7,000 indicated horse power for normal draught and 12,000 horse power for forced draught. Calculated velocity of the vessel, 20½ knots per hour.

The hull is of steel, best quality, and is divided into compartments by means of water tight bulkheads. She has three decks, and is protected by armor varying from 3 to 4½ in. The stem, stern, rudder, etc., are of steel. She has a capacity of 1,200 tons of coal, sufficient to drive her a distance of 12,000 to 13,500 knots. She is provided with electric lights, telegraphs, and all the latest accessories for a vessel of the first class. She carries twelve small boats, of which three have steam. Her armament consists of four Hontoria cannon of 7 in., six of 4¼ in., six Hotchkiss guns, and various other repeating small arms. She has five torpedo tubes—two in the bow, one in the stern, and one on each side.

Our engraving shows a general view of the Reina Regente, also a plan of her battery deck.—*La Ilustracion Espanola.*



THE NEW SPANISH WAR STEAMER REINA REGENTE.

Chicago Cable Roads.

The North Chicago Street Railway Company has laid one mile of tunnel on Clark Street for the new cable line. The tunnel is of steel and continuous, and the manholes, which are of new pattern, are placed every 31½ feet. A 9 inch sewer pipe, opening every 300 feet into the main sewer, is laid between the tracks, into which a pipe runs from each manhole, affording complete drainage. The engine to be located on Clark Street, near Division, is to be of the Corliss type, 2,000 horse power, and built by Messrs. Robt. Wetherill & Co., Chester, Pa. The winding machinery is of new design, with a compensating arrangement to take up the wear on the drums. The pulleys which carry the cable are 18 inches in diameter.

The New Woodward Colliery.

The greatest mine of the anthracite regions will be the new Woodward colliery near Wilkes-Barre. It is being developed by the Delaware, Lackawanna, and Western R.R. Company, who have a tract of about eight hundred acres at that point. The main shaft was commenced in 1881, and is the largest opening in the anthracite fields, being 12 × 55 ft. in size. There are four hoisting ways, one pump way, and an air way, the latter two being a portion of the southern division. The shaft is entirely timbered. As the surface is somewhat unstable a rock foundation was found necessary, and solid masonry four feet thick was recently put in to a depth of nearly eighty feet. The shaft was sunk to the Red Ash vein, which was cut at a depth of ten hundred and forty feet. In going down to this seam, the sinkers cut through the same veins as are found in that vicinity, and in some instances the thickness was surprising. The array of coal in this shaft was pronounced the most extensive in the Wyoming region. The quantity of water in this opening is very great and will require three Knowles pumps to keep it clear. The air shaft is located about one hundred yards from the main opening. The shaft is 10 × 37 feet in size, has two hoisting ways, and cuts the Red Ash vein at one thousand and three feet. This shaft is timbered, and now remains idle and full of water, pending surface improvements.

Two immense ventilating fans of about forty feet in diameter are to be constructed for these shafts. For the first hoisting ways of the main shaft, first motion engines of 24 in. cylinders and 48 in. stroke are now being arranged, while those for the lower hoisting ways are direct acting, with 24 in. cylinders and 60 in. stroke. The two conical drums are 14 and 16 ft. in diameter. Engines of the same size as those at the main opening are being located at the air shaft. Over thirty cylindrical boilers will be required to furnish the power for the vast amount of machinery of the mine. The guides are now being inserted in the main shaft, and about three hundred and fifty feet of water still remain to be pumped out, when the sump will be cut in the Red Ash vein. Lodgments will be cut for the Knowles pumps, three being required for each orifice. The immense trestling from the main shaft to the site of the breaker is nearly completed. It is nearly six hundred feet long, and at one point is over one hundred and thirty feet high. The foundations for the immense double winged breaker are being constructed, and have the appearance of being natural terraces. The breaker, which is to be commenced at once, will be one hundred feet wide, will consume 1,150,000 ft. of lumber, and the capacity will be 3,000 tons per day. In order to furnish a foundation for the breaker, a large creek was turned inland about seventy feet for quite a distance, at a great expense. The gangways of the mine will be opened up as soon as a place can be arranged to stock the coal. The colliery will probably be in full working order within a year, and employment will be furnished about twelve hundred hands. The surface buildings are nearly all contracted for. The head house of the main shaft is one hundred and one feet high, and is just completed. W. H. Storrs and T. H. Carey are the superintendents of the mine.—*Coal Trade Journal.*

Ingenious Financiering.

One of our foreign contemporaries relates the following method adopted by the people of Guernsey for providing themselves with a new meat market, which they very much needed, but had not the means at hand to pay for it. But they were determined to have the market, so £4,000 was voted to defray the cost, and notes were issued by the authorities for that amount, and were guaranteed on the "whole of the property of the island, said to be worth four millions." A singular provision was introduced, which rendered these notes worthless outside of Guernsey, and so they were never exported. They were one pound notes, and were numbered from 1 to 4,000. With them the contractor was paid; he paid his workmen in the same money, and those that supplied him with materials. Tradesmen took them for goods, landlords for rent, and the authorities for taxes. "In due season," to quote from Jonathan Duncan, "the market was complete. The butchers' stalls, with some public rooms constructed over them, were let for an annual rent of £400. At the first year of tenancy the States called in the first batch of notes, numbered 1 to 400, and with the £400 of real money received for rent redeemed the £400 of representative money expressed by the 'meat market notes.' At the end of ten years all the notes were redeemed through the application of ten years' rental; and since that period the meat market has returned a clear annual revenue to the States, and continues to afford accommodation without having cost a farthing in taxes to any inhabitant."

Over Sixty-seven Miles an Hour.

On Nov. 16 a Michigan Central train on the Canada Southern division, having on board a number of directors and officials, ran from St. Clair Junction to Windsor Dock, a distance of 107 miles, in ninety-five minutes, being at the rate of over sixty-seven and a quarter miles per hour.

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SOME ANCIENT INVENTIONS.

More than two thousand years ago, Hero (or Heron), a philosopher and mathematician of Alexandria, invented the fountain shown in the annexed engraving. This device, because of its antiquity as well as its simplicity and completeness, is very interesting and instructive.

As represented in the engraving, it may be classed with toys, or at most regarded as only an apparatus for illustrating a scientific principle; but it is more than this. It is the progenitor of a number of modern inventions for raising water and producing air pressure.

The curious feature of the apparatus is that it apparently causes the water to rise above its own level by its own pressure, but such is not the case. Its action is due to the transference of the pressure of one column of water to another column of water at a higher level, through the medium of a column of confined air. It is as truly a case of the application of external power as it would be if a steam air compressor were applied.

The water to be elevated is contained by the upper bulb, which communicates at its lower side with the

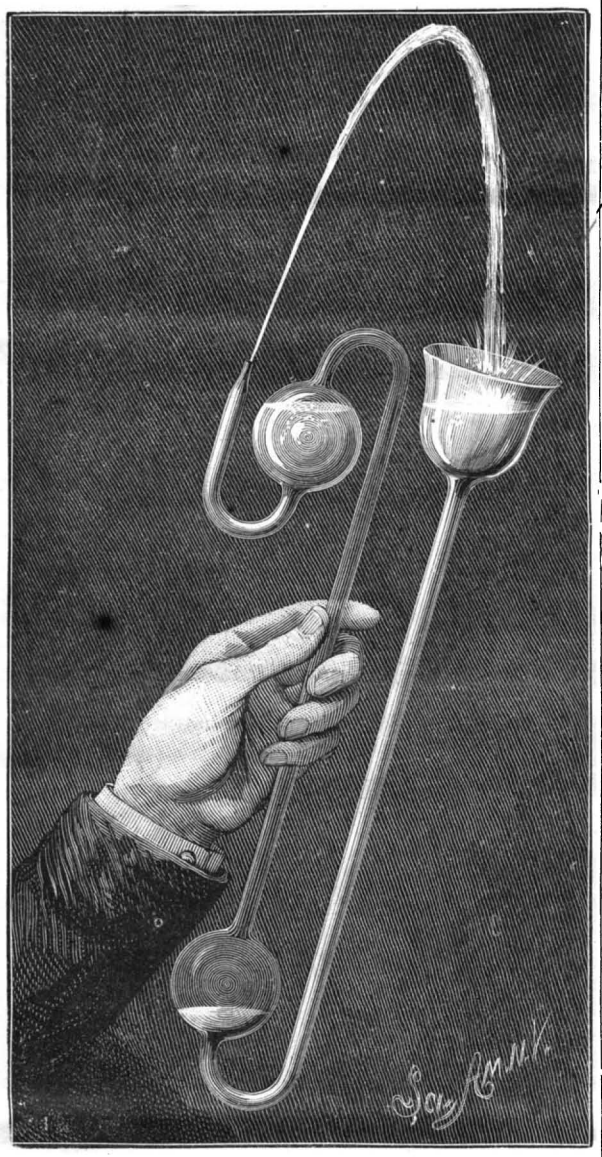

Fig. 1.—HERO'S FOUNTAIN.

fountain nozzle, and at its upper side with the downwardly curved tube connecting with the top of the lower bulb. A tube connecting with the lower side of the lower bulb extends upward to the level of the upper bulb, and terminates in a flaring cup.

The upper bulb, having been filled with water and the lower bulb with air, the fountain is started by pouring a small quantity of water into the cup, which by flowing downward through the tube connected with the cup exerts a pressure on the air contained by the lower bulb. This pressure is equal to the weight of the column of water in the tube. The air pressure thus created is transferred to the top of the upper bulb by the air column rising from the lower bulb through the tube connecting the two bulbs, so that the pressure of the water column descending from the cup, less a very small allowance for friction, is effective in forcing the water out of the upper bulb through the fountain nozzle.

The proper inclination of the apparatus directs the water jet so that the water falls into the cup and replaces the water used in creating the air pressure in the lower bulb.

When the lower bulb is filled with water and the water has been entirely discharged from the upper bulb, the action of the apparatus ceases; but it may be again started by inverting the fountain, allowing the water in the air bulb to run into the upper or water bulb, then righting it and again pouring a little water into the cup.

This device was employed during the last century for elevating water in the mines of Hungary.

In Fig. 2 is shown an interesting modification of Hero's fountain. The apparatus is made of glass, to illustrate the principle on which it operates. It consists of a volute coil of tubing connected at its center with a hollow shaft communicating with a hollow journal box, from which a standpipe rises. When this coil is turned in the direction indicated by the arrow, water and air assume in the coiled tube positions relative to each other as shown in the engraving; the water being arranged in a series of curved columns on one side of the center of the wheel, the air being correspondingly disposed on the opposite side of the center. The height to which the water will be raised by this machine is equal to the sum of the height, above their upwardly curved lower ends, of all the curved columns of water contained by the coil. It will be noticed that the pressure of one curved column of water in the coil is communicated to the next through the intervening air, which weighs practically nothing.

This machine was invented by Wirtz, of Zurich, in 1746.

"In 1784 a machine of this kind was made at Archangelsky that raised a hogshead of water in a minute to an elevation of 74 feet, and through a pipe 760 feet long."

At first sight this pump might be confounded with Archimedes' screw or with the tympanum or scoop wheel, but it differs materially from these in its ability to force the water far above itself by virtue of its cumulative action.

Diamonds: Their Origin, Formation, and Uses.

Diamonds have been objects of interest both to the ancients as well as they are at present to all classes, but more especially to scientists and savants, to whom, even up to this present age, they are a mystery, as to their origin or formation. Though known to be composed of pure carbon, Pliny, as well as other ancient writers, seems to have been ignorant as to their characteristics, being imbued with more superstitious ideas than a true practical knowledge or estimate of their powers of resistance, believing they could only be crushed by a previous bath of goat's blood. Persians give special veneration to the diamond, owing to their belief that they fell from the heavens at the earliest creation of the world. Others attribute them to be of celestial origin, as aerolites, possessing electric light; others, again, believe them of vegetable origin, as some are found with water cavities, also vegetable as well as animal matter embedded in them. Workers in them seem to have a more true and practical knowledge of them, and feel convinced they are more of a volcanic origin, and their surmises may be correct, by the recent discovery in South Africa, where most of the supply is derived from the bed or mouth of an exhausted crater. Also in the discovery, within the past half century, of its sister morphonic gem, called "carbonato," which to an inexperienced eye (in some stages of its formation) has the outward appearance of crystals of emery, and when broken looks like fractured hardened steel; again, in other stages the appearance of porous lava; but even to the worker, as well as the scientist, their progressive age of formation still remains a mystery. It is impossible to say whether the above is an old or young diamond, being an opaque combination of minute gray crystals, compressed together by some natural force into such a dense form and temper as to make its sister lamellar and transparent gem subject to its attrition; and an invaluable adjunct in the mechanic arts. Again, we see the diamond in its transition state of formation from carbonato to that of a granular lamellar diamond flakes, and then progressing (if one may presume to so call it) into the opaque carbonacular form called borts (like rough molten balls of glass), and when broken furnish fibrous splinters like asbestos, which are used for drilling holes in jewels, etc. Finally, they verge into the lamellar translucent and transparent state, having a cleavage like mica, of geometrical forms. Some of these crystals are formed with other small octahedron diamonds embedded in the side facets. As to the uses of the diamond in various ages and by different nations, they are undoubtedly prehistoric, and might be classed in their uses among the stone age. It has been conceded by modern savants that they must have been used in the days of the Pharaohs for something besides amulets. At a meeting of the Anthropological Institute of London, not long since, by a reading before them, Mr. W. M. Flinders had collected evidence in a tomb at Gizeh that tools armed with jewels had been used in the form of solid or tubular drills, as well as saws. The lines in cutting stone with these tools leave an unmistakable trace of their workings, which no other tool does.

The unfinished obelisk at the Egyptian quarries, which has been lying there for over 4,000 years, has continuous spiral grooves, being of uniform depth, showing the cutting edge of the tool was not in any wise impaired. Diamonds had different names in various ages, among nations and tribes. In the days of Solomon, "samer" or "shamer," after the miraculous stone-working worm of that name; by the Egyptians, auerchilis or chalazias; Grecian, adamas or adamantine; and by the Jews, iahaome, etc. Thus lost arts are being restored to us by scientific research, and in recent years as well as the present. We now see the diamond advertised in multitudinous branches of arts. We had occasion, in our issue of May 5, 1876, to refer to diamonds and their uses, since which they have been growing rapidly in favor for trimming or truing chilled iron, paper calender and porcelain rolls, emery wheels, sawing and trimming stone, boring rock for tunneling and prospecting mines, etc.

The Vertigo of the Kajak.

Mr. Hastrup, a physician of North Greenland, has observed a curious affection that attacks the Esquimaux. Its name in the Esquimau vernacular is the equivalent of our term "boat fright;" but Danish physicians call it "Svimmelhed i Kajak," or vertigo of the kajak (*Hospitals Tidende*, August 18, 1886; *Rev. internat. des Sc. med.*, September, 1886; *Med. Record*).

The disorder is described as follows: An Esquimau, while sailing in his kajak upon a perfectly calm, smooth sea, is suddenly seized with a feeling that his boat is tipping to one side. He jumps to the other side to perserve the equilibrium, but this only makes matters worse, and he abandons himself to anxious and even

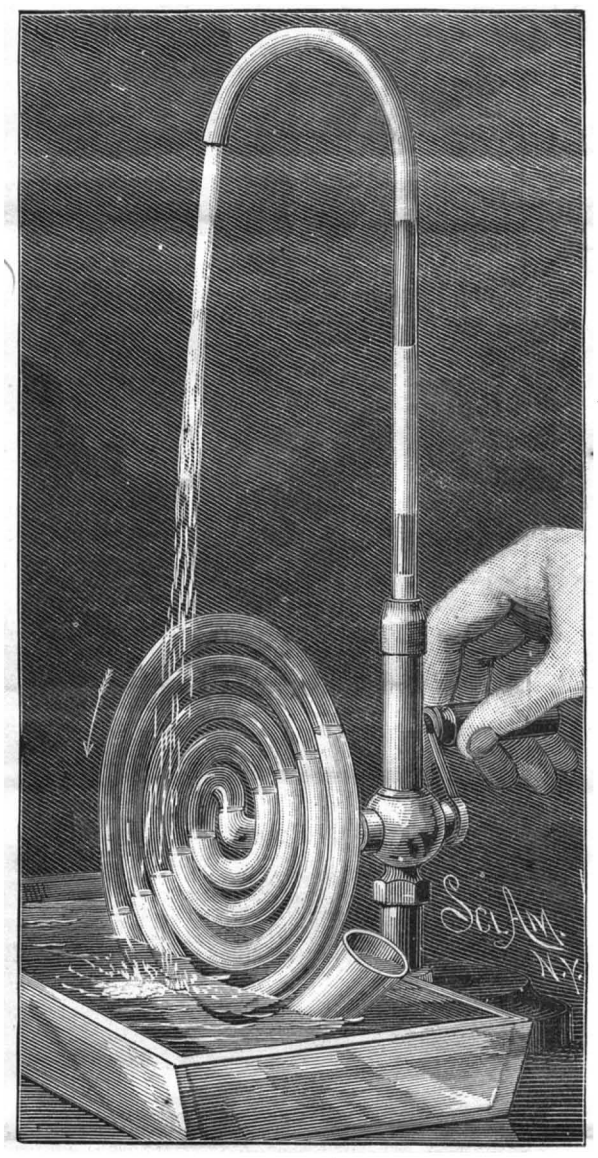

Fig. 2.—WIRTZ'S PUMP.

frenzied attempts to keep the boat from tipping. He can no longer fish, and his trouble does not cease until he gets in sight of shore or of another boat. These attacks are not accompanied or preceded by any malaise or nausea. There does not appear to be true vertiginous sensations, but there is rather an hallucination of the sense of equilibration. The disorder attacks the Esquimaux when they are apparently in full health, and it is not accompanied with headaches, tinnitus, palpitations, convulsions, or paralyses. It may last a lifetime, or go away as it comes, quite suddenly. It is a great misfortune to the patient, since he can no longer fish, and is practically an unproductive member of society. The disease has been attributed to the excessive use of coffee and tobacco, but Mr. Hastrup has observed it in men who used neither of these substances.

A Ten-Inch Draught Steamboat.

A steamboat has been built to navigate the Allegheny River between Pittsburg and Kittanning, a distance of 45 miles. Although 142 ft. long and 25 ft. beam, she draws but 10 in. of water. It has been nearly or quite twenty years since steamboat packets ran on the Allegheny, and it has been believed that the railroads had crowded them off for all time, but the builder of the craft mentioned—the Nellie Hudson—believes that there is still a chance for a line of properly constructed boats, and, if this first venture pays, we believe he intends to add other boats, and perhaps run some of them as far up as Oil City.

There must be many streams navigable for steamers of light draught like the above. It only requires a little enterprise to make them available.

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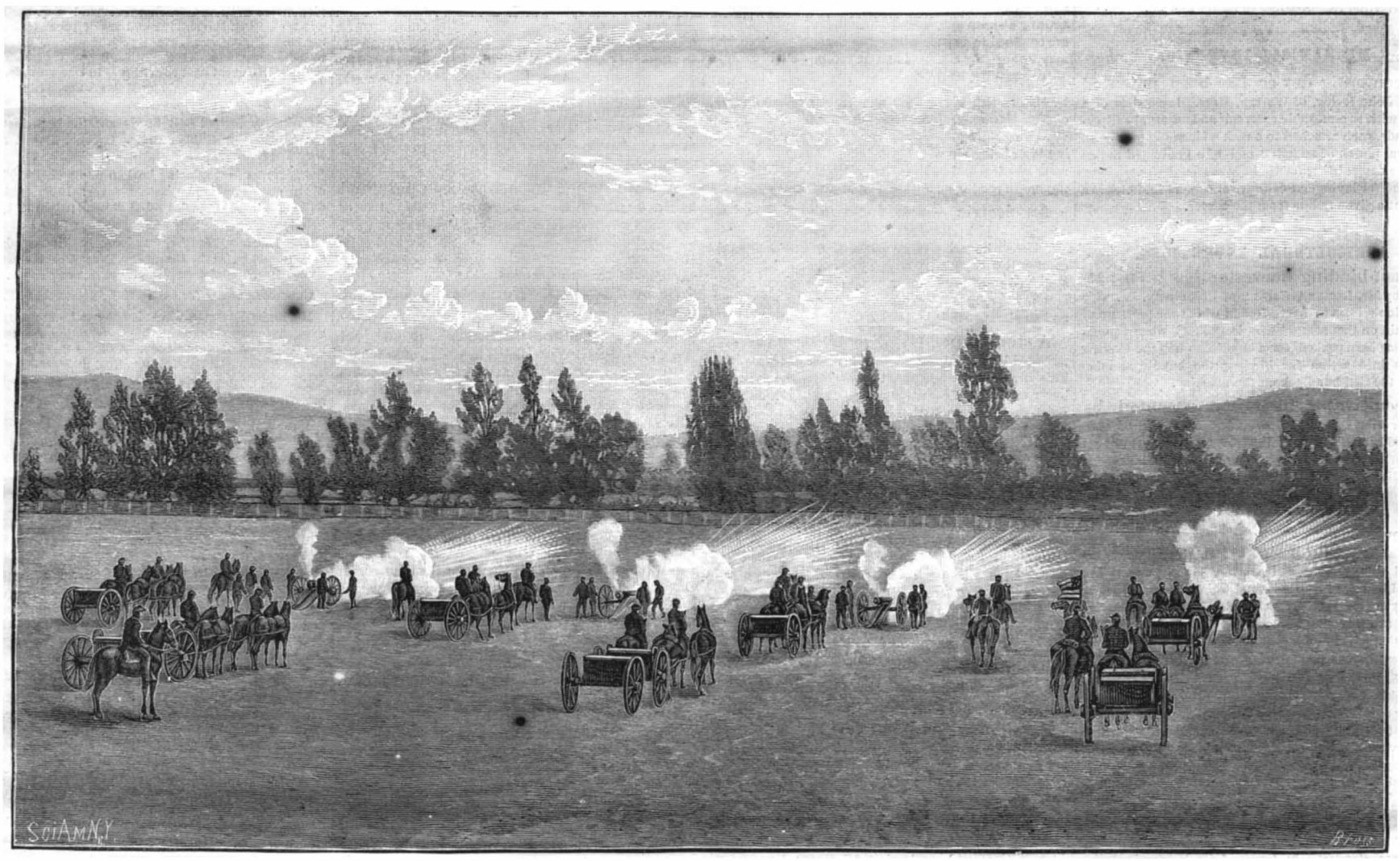
EXPULSION OF UNBURNED GUNPOWDER FROM CANNONS.

It has long been known by students of gunnery that the combustion of gunpowder in cannon, especially in those of short caliber, was imperfect. The result of this fact is that a quantity of powder is blown out of guns when fired, in grains, burning as it goes through the air. The erosion of the bores of cannons is probably effected by this cause. In a recent article, Sir Frederick Abel attributes erosion to the action of gas vapors and liquid products upon the heated surface of the bore. When it is known that a large quantity of powder is driven out in the solid form, its influence on the process of erosion should not be lost sight of. In muzzle loaders, where a considerable windage exists above the ball, the wear takes place in the upper surface of the piece. The products are driven through the gap with great velocity, wearing away the metal. In breech loaders, where the shot fits tightly, and there is no such windage, the wear is more evenly distributed. This has given rise to a division of the effect into "muzzle-loading" and "breech loading" erosion.

The 7 inch gun, muzze-loading, and weighing 7 tons (English ordnance), began to first show this feature of deterioration. After firing 600 rounds it was seriously injured. The heavier the gun, and consequently the charge, the worse the effect has proved. The large currence is rendered visible. Each bright line presumably shows the path of a grain of incandescent powder.

In cannon of large caliber, where heavy shells have to be expelled, an instantaneous deflagration of the powder is inadmissible, as it would strain the gun. The powder is made in large grains to secure slower ignition. This avoidance of sudden ignition tends to cause the loss of powder we are describing. The lengthening of the pieces is a step in the direction of avoiding this trouble, though of course increased weight and awkwardness of the cannon results from taking it.



ARTILLERY FIRING.—(From an Instantaneous Photograph.)

amount of powder expelled in the solid form, even from small guns, and burned outside the gun is clearly shown in the accompanying engraving. It suggests strongly how large a factor solid powder may be in the scoring of gun tubes.

Two interesting photographs illustrating the phenomena attending the discharge of light battery pieces have been received through the courtesy of Mr. Geo. T. Ruddock, of San Francisco, Cal. Light Battery K, U. S. Artillery, stationed at the Presidio in San Francisco, takes annual practice marches. During a recent march to Monterey, the photographs in question were taken at San Jose. The photographer was Lieut H. E. Harris of the Battery, Instructor in Photography in the U. S Army. One of them we reproduce, showing the expulsion of unexploded powder from guns. In front of the smoke escaping from the mouth of each piece, bundles of horizontal lines are shown, presumably due to powder unconsumed, but burning a it is driven through the air. In the photograph the delicacy of the effect is unsurpassed. The picture is quite remarkable. A perfect tassel of threads of light is seen extending out from the cannon. The effect cannot be adequately reproduced in our engraving.

Another interesting feature to be noted is the simultaneousness of the discharges, as indicated by the equal height of the columns of smoke above the touch holes. It seems doubtful if the escape of unburned powder was ever before so graphically shown. By firing at screens, the fact of the escape has often been proved by the marks made by the powder upon them; but in the photograph here reproduced, the actual oc-

Paste for Labeling.

1. Tragacanth, 1 oz.; gum arabic, 4 oz.; water, 1 pint. Dissolve, strain, and add thymol, 14 grains; glycerine, 4 oz.; and water to make 2 pints. Shake or stir before using it.

2. Rye flour, 4 oz.; alum, ½ oz.; water, 8 oz. Rub to a smooth paste, pour into a pint of boiling water, heat until thick, and finally add glycerine, 1 oz.; and oil of cloves, 30 drops.

3. Rye flour, 4 oz.; water, 1 pint. Mix, strain, add nitric acid, 1 drachm, heat until thickened, and finally add carbolic acid, 10 minims; oil of cloves, 10 minims; and glycerine, 1 oz.

4. Dextrin, 8 parts; water, 10 parts; acetic acid, 2 parts. Mix to a smooth paste, and add alcohol, 2 parts. This is suitable for bottles of wood, but not for tin, for which the first three are likewise adapted.

A paste very similar to 3, but omitting nitric acid and glycerin, is also recommended by Dr. H. T. Cummings.—*L. Eliel, Am. Journ. Pharmacy.*

Magnets.

It is somewhat strange that the journals identified with the milling interests have never had much of anything to say regarding the use of magnets in flour mills. This cannot be because magnets are of slight importance, for many educated and intelligent millers know their great value. But it is, nevertheless, true that magnets are seldom mentioned in milling journals and are still unknown in far too many mills, large and small. To be sure there are regions, though becoming few and far between, where the absence of wire-binding harvesters, and the exercise of unusual care in garnering, diminish the danger to reels and rolls from bits of metal; but even under such conditions it would undoubtedly be a wise precaution and an economical measure to employ magnets. It is quite a common practice to fix them in gangs in the wheat spout, and if well done this will doubtless be effective for a while; but they soon become choked with captured fragments, and must be frequently cleaned if they are to do satisfactory work.

In any event, they are not really cheap; for if well attended they take valuable time, and if ill attended they become worse than useless. For instance, we were once in a mill where the shorts betrayed unmistakable traces of metallic substances. The miller admitted their presence, but declared that he could not account for it. Did he use magnets? "Oh, yes, of course." Yet when he showed them to us, he found to his surprise that they were either deficient in power or so loaded with broken wire, nails, screws, etc., as to be practically ineffective. We have also seen rolls the surfaces of which were cut and scratched to an extent which showed that they must have been regarded by the miller in charge as fit receptacles for miscellaneous hardware; and how he could expect them to remain in perfect alignment and parallelism under such treatment is quite beyond our powers of conception.

The demand, then, is for a device which will do its work well without constant watching and cleaning—that is, some arrangement in which the magnets are automatically and regularly cleaned. These points have been embodied in the "magnetic separator," an invention which is almost infallible in detecting and arresting unwarranted metallic intruders. Once in a great while something will make its way past a separator and leave its mark on the rolls, but a suitably protected, closed spout, leading from the discharge of the separator to the first-break hopper, is almost certain to prevent such an occurrence.

Probably one-half the magnets sold to millers are practically worthless for use in flour mills. When tested, they prove to be insufficiently charged, and hence have but limited power to attract pieces of metal. A good ten inch magnet should be able to lift a twelve pound weight and hold it, but we have seen many that would not hold one pound. The steel for a reliable magnet must be of even and close grain, by no means soft, for its power depends on this in a measure. It not infrequently happens that two pieces of steel of the same rolling will make magnets of different strengths, and it is only by years of study and experience that a manufacturer can be sure of always producing well charged magnets. He has to go through with many experiments, using different grades of steel, before he can tell which is best for his purpose. It is therefore not to be expected that a good separator can be had for a song, although its price is not beyond the means even of the small miller.

First be sure that you need a separator, then go ahead and get one of the first class. Don't be satisfied with anything less. This is true economy.—*Roller Mill.*

PROF. RIPLEY NICHOLS, of the Massachusetts Institute of Technology, Boston, died in Hamburg, Germany, July 14, 1886, aged about forty years. He was a distinguished analytical chemist, particularly of water, in which he obtained a well deserved reputation. He was also the author of a number of scientific essays, and the author of several excellent scientific text-books. He was abroad at the time of his death with the hope of gaining relief from pulmonary disease, with which he had been a sufferer for many years.

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ENGINEERING INVENTIONS.

A car coupling has been patented by Mr. Frank Vaughan, of Elizabeth City, N. C. This invention covers a novel construction and arrangement of parts for a coupling, intended to be inexpensive to make, and yet efficient in operation, and which can be used to couple with other cars not provided with the same kind of coupler, whether they be higher or lower.

An express car has been patented by Mr. John D. Condon, of Kingsley, Iowa. It is plated or covered with sheet iron, the windows have iron shutters, and the space inside is divided by vertical partitions into a large central space, with a small room or rooms at the ends, there being sliding or swinging inside iron doors, with other novel features, to make a substantial construction and promote safety.

A quieter for locomotive exhaust nozzles has been patented by Mr. Russell Thayer, of Philadelphia, Pa. It consists of a cup attached to a rock shaft journaled in and extended beyond the side of the smoke box, and having an arm connected with a rod extending to the cab of a locomotive, so that the engineer or fireman can readily turn the quieter down over the exhaust nozzle or swing it back out of the way.

An apparatus for converting motion has been patented by Messrs. John F. Loomis and Byron E. Wing, of Shelby, Iowa. It consists of a vertically reciprocating rack bar, in connection with two parallel shafts having gear wheels on their outer ends, and having rigidly secured upon them, near their inner ends, hollow flanged disks, the disks turning loosely on the inner ends of the shafts, with other novel features, for converting reciprocating in rotary motion.

MECHANICAL INVENTION.

A centering device has been patented by Mr. John Irving, of Warren, Mass. It consists of a frame with two movable external and internal calipering heads, each attached to a rack which is in gear with a central pinion of an index and of a graduated radius bar, the device being for centering rods, shafts, pinions, etc., and for laying out cylindrical centers for holes in a circle at a given radius from the center.

AGRICULTURAL INVENTIONS.

A self-binding harvester has been patented by Mr. Lucius A. Carson, of Uniontown, Pa. This invention relates to harvesters in which the pressure of the grain on the compressors is utilized, when enough grain has been packed for a bundle, to trip the binding devices into action for binding the bundle, and discharge the tied bundle from the machine.

A cultivator has been patented by Messrs. John C. McCandless and Orson King, of Randolph, Kan. This invention covers an improvement on a former patented invention of the same inventors, for cultivators for listed corn, and is designed to adapt them for use in cultivating all kinds of plants planted in rows or drills upon the surface of the soil.

A cultivator has been patented by Mr. Nicholas H. Vogt, of Goff's, Kan. This invention covers a novel arrangement and combination of parts in that class of listed corn cultivators which have twisted or spirally curved and inclined blades for cutting into the furrow and throwing the loosened earth toward the row of plants.

A seed planter has been patented by Mr. Louis S. Flatau, of Pittsburg, Texas. It is of the class of walking planters, being particularly adapted for sowing cotton seed, but also designed for planting corn and distributing fertilizers, and the principal feature of the invention is the novel construction of the seed-discharging device, arranged to rotate in the bottom of the seed hopper.

A bundle carrier and dropper for harvesters has been patented by Messrs. Luke and Charles H. Moffatt, of Verndale, Minn. Combined with the apron are standards in front of its lower edge, with connections secured at one end to the lower end of the apron, the other ends engaged with and movable on the standards, with other novel features, making a useful attachment for harvesting machines.

MISCELLANEOUS INVENTIONS.

A ruler has been patented by Mr. William P. Sisson, of Garnett, Kan. It has attached to it a finger socket or clamp to facilitate the use of the ruler, and avoid its slipping and making false lines or blots.

A cuff button has been patented by Mr. William Riker, of Newark, N. J. This invention covers a special construction of the plate and the post in that class of buttons that are adapted to be screwed or turned into and out of the button holes of the cuffs.

A revolving exhibitor has been patented by Mr. William F. Miller, of Butler, Pa. It has a fixed circular base, which is hollow and has a motor for reversing an upwardly projecting pin, moving a vertical shaft and rods, for exhibiting dry goods, notions, jewelry, and other articles to great advantage.

A sprag for mining cars has been patented by Mr. John J. Newbaker, of Steelton, Pa. The car wheels have lugs, and the sprag is adapted to slide on the car body and engage with the lugs, whereby the speed of the cars can be checked or they can be entirely stopped while descending steep grades.

An obstetrical instrument has been patented by Mr. Frederick Hullhorst, of Yutan, Neb. It combines in one hand tool a clamping means for tying the umbilical cord, by closing metal clamps or ligatures on or about it, and an interposed cutter for severing the cord between the closed clamps.

An individual condiment holder has been patented by Mr. George D. Dowkontt, of New York city. It is made to be held upon the plate by a simple downwardly projecting flange, which also serves as a support when removed from the plate, the holder having one or more recesses to receive condiments.

An adjustable organ pedal has been patented by Mr. John T. Rowe, of Aylmer, Ont., Canada. A pedal-carrying frame is fitted to slide vertically on the organ case, with flexible webbing or bands connected to the bellows and the free ends of the pedal, with other novel features, whereby the pedals may be easily raised and lowered to suit children or adults, without affecting the working of the bellows or attaching or detaching any of the parts.

An upright piano case has been patented by Mr. Hermann Toaspern, of Brooklyn, N. Y. The invention consists in combining with the case a music holder arranged below the key board, and adapted to be swung outward for convenience in putting away and taking out sheets of music.

A music rack for pianos has been patented by Mr. James F. Conover, of New York city. Combined with an upright piano case, having an opening in its front, is a rack or panel with bars hinged near the bottom to the piano case, and with curved slotted arms, so that the rack, when lowered, is inclined some distance from the front of the piano, the rack, when up, filling the front opening like an ordinary piano panel.

A music leaf turner has been patented by Mr. William H. Fesler, of Columbiana, Ohio. This invention covers a novel construction and arrangement of parts designed to provide an efficient device for quickly turning the leaves of music or music books, or for turning single sheets of music.

An ant trap has been patented by Messrs. Robert H. Barnes and George C. Salles, of Cuero, Texas. It is made with a circular flanged pit and tubes leading therefrom to a central ant receptacle, making a cheap and effective device, whereby the ants are confined to a space within the circle of the trap, and may be speedily captured and exterminated.

A roofing retainer has been patented by Messrs. Ernest D. Owen and Homer Lichtenberger, of New Harmony, Ind. This invention relates to devices for holding the roofs on buildings, and preventing their being blown off, consisting of a novel arrangement of wires and saddles, especially adapted for holding on tin roofing and other similar styles.

An electric alarm for time pieces has been patented by Mr. Frank Glasgow, of Osceola Mills, Pa. The spring arbor of an alarm clock carries a crank, combined with which is an electrical contact lever, with a pivoted releasing lever extending into the path of the crank, whereby an electric circuit may be completed and an alarm sounded electrically.

A stereotype casting machine has been patented by Mr. John E. Caps, of Kansas City, Mo. This invention covers means whereby the upper and lower members of the casting box may be heated as desired, each section being chambered, and there being a steam pipe connection communicating between the sections and a supply pipe from the boiler.

A vegetable masher has been patented by Mr. Nils Johnson, of Superior, Wis. It is so made that in a suitable closed receptacle a shaft is revolved to carry knives or beaters through the material, to be beaten and mashed between the edges of beaters and of cross bars, whereby large quantities of potatoes, turnips, etc., may be quickly and thoroughly mashed.

An animal trap has been patented by Mr. Alphonzo Becker, of Waterford, Pa. Combined with a base having an edge-like rib, by the side of and below which is a bearing for the bail, is a spring-actuated bail, with a trip mechanism, easily operated by a trigger, with other special features, making a novel trap of simple construction.

A hitching strap holder has been patented by Mr. Edward R. Campbell, of Austin, Minn. It is a wire bent to form a loop with laterally projecting arms, there being a shank portion below the loop and attaching eyes in the free ends, it being designed to be attached to the back strap of a harness just in advance of the hip straps.

A wardrobe trunk has been patented by Mr. Zalmon D. Hinkley, of Grand Rapids, Mich. It is a traveling trunk, made with suitable folding and separate parts, to constitute convenient partitions and tills, when in position in the trunk in its customary form, which, by hinges, locks, and fastenings, are held in place as a trunk proper or to make a wardrobe.

A wrench has been patented by Messrs. John M. and William H. Parsons, of Great Western Mine, Cal. It has a lever arm with jaws to engage the nut, and arms with clamps to engage with the spokes of the wheel, being designed to hold a nut or burr to its place against the outer end of the hub when removed from the axle, when the latter is being lubricated.

A corset fastening has been patented by Mr. Louis Sanders, of New York city. It is a metallic spring loop fastening, of novel form, to engage with buttons or studs, intended to hold securely, but so it can be readily engaged and disengaged, and not liable to accidental engagement again when the corset is being taken off.

A water heater has been patented by Messrs. John H. Swager and Jacob F. Ferchen, of Astoria, Ore. It is intended to be fitted upon the ordinary form of cook stoves, and consists in one or more annular chambers in connection with a water supply tank, with certain novel arrangements of stop cocks and faucets.

A coal chute has been patented by Mr. James Jopling, of What Cheer, Iowa. It has a sliding and laterally adjustable scuttle, in connection with an inclined chute and an intermediate hinged curved plate, with devices for operating the scuttle and the plate, being designed as an improved coal heaver for loading box or flat cars with coal without moving the cars.

An ironing machine has been patented by Mr. Jean L. Mazoyer, of New York city. It has a reciprocating table and a reciprocating roller above it, both operated from the same shaft, so the machine can be run by a man turning the crank wheel with one hand and placing and removing the articles with the other hand, or it can also be operated by power.

A firewood drag saw has been patented by Mr. Benjamin F. Shinn, of New Iberia, La. Combined with a supporting frame and inclined ways is a reciprocating cross bar mounted on the ways, with a saw arm adjustably pivoted on the cross bar, and means for reciprocating, so that the saw will swing back and forth in an irregular curve, instead of in a horizontal plane.

A reversible car seat has been patented by Mr. John M. Sauder, of Harrisburg, Pa. The seat is made with its back rigidly connected with the seat frame and arms, but with a novel construction of reversing mechanism, whereby it can be moved inward and upward, swung through half a revolution, and moved outward and downward to its place, the seat being economical in space and inexpensive.

A loom for cross weaving has been patented by Messrs. George Oldham and William Dixon, of Philadelphia, Pa. The invention provides means for giving the heddles lateral horizontal movement for crossing the warp threads between the strands of filling, with a special construction of harness or plates to carry the warp threads, in looms for making chenille, rugs, mosquito netting, etc.

A night light has been patented by Messrs. James and William J. Stratton, of Brooklyn, N. Y. It has a support formed with a swinging joint, a burner which supports a screen having a cylindrical section and a lateral cone shaped section, with a lens supported by a swinging joint in front of the cone shaped section of the screen, whereby the light from a small lamp may be directed on any desired object, and the rest of the room be shaded.

Combined mast head and foot gears forms the subject of a patent issued to Mr. John H. Rushton, of Canton, N. Y. The invention covers swiveling devices applied to the head and foot of the mast, made free to rotate, and having the blocks through which the halyards or other ropes run attached to them in a free or loose manner, with other novel features, to allow sails, spars, and cordage to turn freely and without fouling.

A washing machine has been patented by Mr. Stephen T. Potter, of Marshall, Mo. It is of that class wherein a revolving perforated drum is used, and the drum is provided with a sliding door held at its ends in circular grooves formed at the ends of the drum, whereby the door may opened by simply sliding it in the grooves, the design being to simplify and perfect the machine.

A washing machine forms the subject of a patent issued to Mr. Eaton K. Clark, of Sequiour, Iowa. The tub has vertical vibrating arms pivoted at their upper ends, and by operating a crank the clothes are pressed between corrugated plates to wash them, with a pressing and rubbing movement, in a machine designed to be simple in construction and convenient in use.

A cigar bundling machine has been patented by Mr. T. Wilson Haus, of Meadville, Pa. The invention consists in a box having a side and bottom follower, with a trestle to support and raise the bottom follower, a screw connected with the side follower, movable triangular corner blocks, and an apertured cover with a slide for closing the aperture, making a convenient device for bundling cigars and holding them while being tied.

A brake for children's carriages forms the subject of a patent which has likewise been issued to the above inventor. It is a bar or plate attached to the axle of the carriage, with a notched clutch plate on the hub of the wheel, with which the brake bar may be engaged, with other special features, making a simple and effective device that may be worked by the foot of the attendant to lock and unlock the wheel.

A compensation pendulum has been patented by Mr. John Gerhardt, of Montreal, Quebec, Canada. The compensating rod and pendulum are both made of the same metal, and are combined with pivoted connecting devices separated at one end by the compensating rod, and from which the pendulum is suspended, so that the contraction of the rod will lower the pendulum and its expansion raise it, exactly as the pendulum contracts and expands under the same temperature.

A barrel head cutter has been patented by Mr. Thomas McMillen, of New Orleans, La. The clamping disk against which the barrel head is held is formed with a curved surface, so that in applying the head it will be bent transversely to the grain and in the direction of its greatest diameter, the invention being an improvement on a former patented invention, but also adaptable to all machines in which the saw mandrel is made to swing toward and from the barrel head to cut it in oval shape.

NEW BOOKS AND PUBLICATIONS.

The Century Magazine. — Volume XXXII. of this publication, including the numbers May to October, 1886, forms a sumptuous book of 972 pages, which, for excellence and beauty of the letter press, high character of the numerous illustrations, and great variety of valuable reading matter, it would be difficult to match, and impossible to surpass, among works devoted to the general culture and entertainment of people of educated tastes. One can hardly realize, while enjoying for an hour or two, with each monthly number, the judicious mixture of luxuries and solid fare there presented, what a noble volume accumulates with each half year; and when these numbers are put together in the beautiful and appropriate binding that the publishers have designed, and furnished with the excellent index that is provided, the book becomes not only a perpetual pleasure in the fireside circle, but forms a substantial addition to any library.

St. Nicholas.—This illustrated magazine for young folks, conducted by Mary Mapes Dodge, and published by the Century Company, New York, affords two handsome books for each twelve numbers, Vol. XIII., parts I. and II., including the year from November, 1885, to October, 1886. In pictorial beauty, typographical excellence, and careful literary work, it is quite the equal of the senior monthly issued from the same house, while in the admirable adaptation of its contents to the tastes of the young it has achieved a success which is unique. Its captivating influences would also, unquestionably, be warmly acknowledged by a wide constituency of readers of mature years. Its pages are always bright and entertaining, and convey much of valuable instruction in a most enjoyable way. The binding provided for each six months' issues is very rich in appearance, and quite accordant in character with the matter inclosed by the covers.

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The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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Curtis Pressure Regulator and Steam Trap. See p. 142.

Universal & Independent 2 Jaw Chucks for brass work, both box & round body. Cushman Chuck Co., Hartford, Ct

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

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Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N.Y. See illus. adv., p. 28.

Supplement Catalogue.—Persons in pursuit of information of any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

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If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN patent agency, 361 Broadway, New York.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(1) J. H. asks how to remove stain, discoloring, or smell, of carbon oil out of wood flooring. A. You might try the effect of spreading a layer of fuller's earth over the wood, but we doubt if a complete removal is possible.

(2) N. S. C. asks how to color water in alcohol so as to obtain the deepest hue (red preferred), suitable for exhibition, in capillary tubes or thin layers. A. Use aniline red, soluble in water.

(3) Librarian asks a recipe for cleaning the leaves of books. A. We know of nothing better than stale bread crumbs. We would recommend you to consult the articles on "How to Clean Old Engravings," in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 115 and 124.

(4) E. S. asks: Is there any preventive of the disfiguring white incrustation which so often appears on brick work? We have just erected a handsome brick structure, and already there are some signs of its appearance. Can you recommend any application which, while not injuring appearance of brick work, would prevent above trouble? A. The incrustation on your brick wall is sulphate of magnesia. Sometimes a cure may be effected by applying, with a sponge, a solution of common muriatic acid, ½ pound in a pail of water; but, if this fail, nothing can be done excepting to brush it off from time to time as it appears. It will eventually exhaust itself.

(5) W. T. W.—The contrivance for enlarging drawings to which you refer is probably the "pentagraph," an instrument which you can obtain at any store where artists' supplies are sold. In copying such drawings as those you send us, some artistic skill would be necessary, although, with a little practice, you would probably make it answer your purpose. Exact enlargements may also be made by photography.

(6) J. S. B. asks: 1. Can the mixture be left in a bichromate of potash cell one year without injury to the carbon plates or to the mixture? A. The mixture will probably creep up the carbons and corrode the connections. The solution will grow stronger by standing and tend to crystallize, and require to be diluted before use. The best plan is to remove it when not in use for long periods. 2. Will the mixture freeze if subjected to a temperature of 0° Fah.? A. It depends how strong it is in sulphuric acid and salts. Probably it would as ordinarily used.

(7) E. S. L. asks for a remedy to keep the hair from breaking. A. We know of no means except cutting the ends. See article on care of the hair in SUPPLEMENT No. 388.

(8) W. R. asks (1) if it is legal or illegal to hold a court of justice in a public saloon in a country town. A. For some purposes and emergencies seeming to justify such action, there would be nothing illegal in so holding court; we know of no special statute governing the matter, excepting those providing for "proper" places for holding court. 2. If a lawyer is behind time, has he any grace? If any, how long? A. Strictly speaking, no; but he is entitled to be heard as to whether he has a proper excuse for delay, and lawyers are so frequently behind time that they all seem to have a "fellow feeling" in the matter, and readily excuse each other. 3. The address of the British Consul? A. No. 22 State Street, New York city. 4. How many tons of hay are there in a bay? The length is 30 feet, the height is 16 feet, and width 15 feet. A. 25 to 30 tons, according to how closely it is laid.

(9) A. C.—American steel is fully equal to English, and largely used all over the United States. Every grade is now made here.

(10) C. C. C. asks: In heating platinum wire for various purposes, (1) how long will the wire bear a red heat? How long will it bear a white heat? A. Platinum wire will bear a red or a white heat indefinitely. 2. Will it last a greater or less time if the heat be intermittent? A. The intermittent application of heat will not affect its durability. Too high a heat, however, will fuse it. This fact has prevented its use in incandescent lamps.

(11) W. T. F. asks: How many diameters is the sun magnified when it is thrown on a screen enlarged to 4½ feet? The telescope used is 40 inches focus, 3 inches aperture, Huygenian eyepiece, equivalent to 1 inch focus. I caused quite a controversy by asking the question of several astronomers; the answers from a number of them have been received, with but two agreeing. The variation is from 40 to 648 diameters. A. The division of the angular measure of the screen projections as seen from the distances of the eyepiece from the screen, by the actual angular diameter of the sun, is the actual linear measure of the magnification. If the screen is viewed by the eye at a less distance than that of the eyepiece, the angular measure must be multiplied by the distance from the eyepiece to the screen in inches and the product divided by the distance of the eye from the screen in inches, for the magnification.

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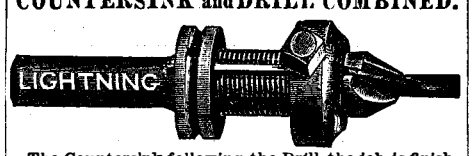

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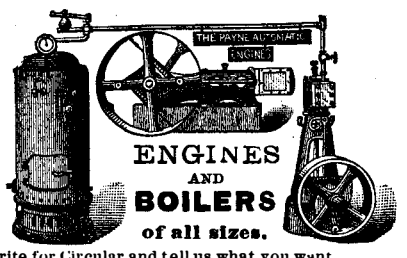

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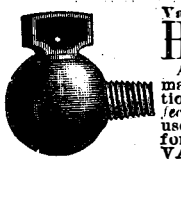

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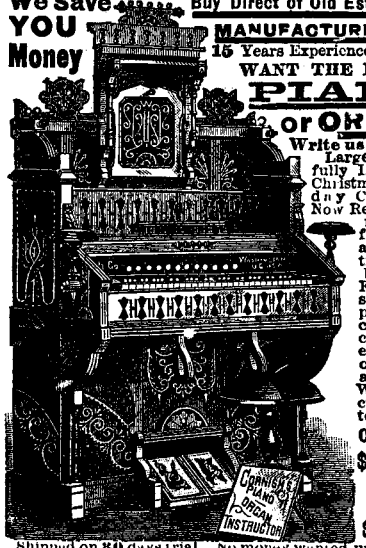

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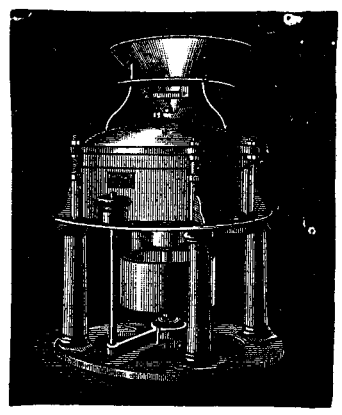

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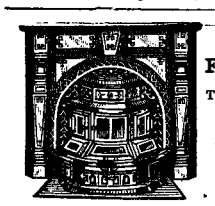

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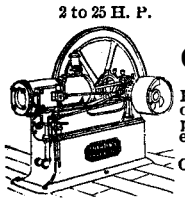

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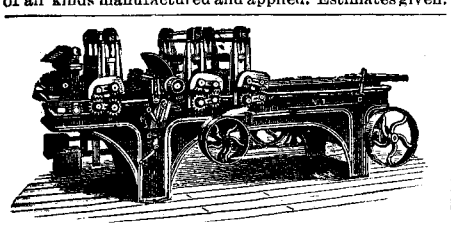

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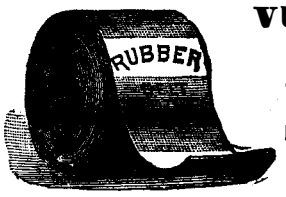

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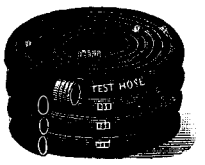

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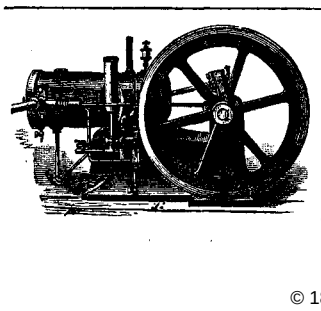

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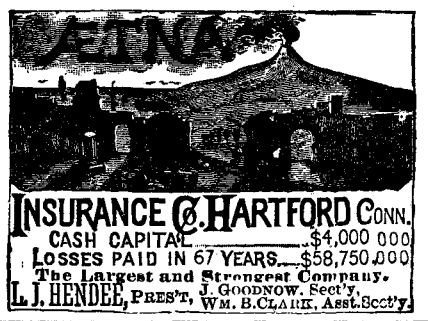
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TO THE STEEL MANUFACTURERS OF THE UNITED STATES OF AMERICA.

UNITED STATES NAVY DEPARTMENT,
WASHINGTON, D. C., Aug. 21, 1886.

The attention of all steel manufacturers of the United States is hereby invited to the requirements of the Navy Department in the way of armor-plates and heavy gun forgings, for the prosecution of work already authorized by Congress.

This advertisement invites all domestic manufacturers of steel to specify, in competition with each other, upon what terms they will engage to prepare for the production of and produce the forgings and armor-plate required for modern ordnance and armored ships; and no bids will be considered except such as engage to produce within the United States either all the gun-steel or all the armor-plate (or both) specified in this advertisement; nor will any bid be accepted unless accompanied by evidence satisfactory to the Department that the bidder is in possession of, or has made actual provision for, a plant adequate for its fulfillment.

Bids are hereby invited for supplying this Department with the under-mentioned material:

About 1,310 tons of steel gun-forgings, of which about 328 tons will be for guns of six inches caliber, 70 tons for guns of eight inches caliber, and 912 tons for calibers between ten inches and twelve inches (both inclusive).

These forgings are to be delivered rough bored and turned, and when in that state the heaviest forging which enters into the construction of a gun of each of the desired calibers will be about as follows:

6-inch	3¼ tons.
8 "	5 "
10 "	9½ "
10½ "	9½ "
12 "	13½ "

All these forgings must be delivered within the following times from the closing of a contract, viz.:

For 6 inch guns, 28 within one year, and the remainder within 18 months.

For 8 inch guns, within two years.

For 10 inch and larger guns, within 2½ years.

Preference will be given for earlier deliveries.

Also, about 4,500 tons of steel armor-plates, to be of the best material and manufacture, shaped accurately after patterns to fit the form of each vessel for which intended, and of such sizes as may be required, varying somewhat as follows:

20 feet by 8 feet by 12 inches thick.
17½ feet by 6 feet by 17 inches thick.
11½ feet by 4¼ feet by 6 inches thick.
There will also be thinner plates.

For information concerning shapes and weights of the gun forgings and armor-plates, what parts must be manufactured in sets, time of delivery of each set, the chemical, physical, and ballistic tests, which the metal must sustain in each case, and for all other particulars, apply to the Chief of Bureau of Ordance, Navy Department, Washington, D. C.

Each bid upon armor-plate must specify the time within which the bidder will engage to make delivery; and preference will be given to earliest proposed deliveries.

Proposals must be in duplicate, sealed and addressed to the Secretary of the Navy, Navy Department, Washington, D. C., the envelopes indorsed "Proposal for steel gun-forgings and armor."

They will be received at the Navy Department until 12 o'clock M. on the 10th day of December, 1886, at which hour the opening of the bids will take place.

The right is reserved to waive defects in the form of, and to reject any or all bids.

Ten per cent. of the contract price will be retained from the payment for each article delivered, until the contract, as far as relates to articles of that class, shall have been completed.

Separate bids may be submitted for the gun steel and for the armor, if any manufacturer so desires; but bids covering both will receive preference, other things being equal.

Bids will be compared in two classes.
First. Gun Forgings.
Second. Armor-plate.

And the total sum for which, and the time within which the whole of the material covered by each class will be produced and delivered will be alone considered.

WILLIAM C. WHITNEY,
Secretary of the Navy.

NOTICE.
NAVY DEPARTMENT,
WASHINGTON, *November* 6, 1886.

The time fixed by the foregoing advertisement, dated August, 21, 1886, for receiving proposals for steel gun-forgings and armor-plates, viz.: December 10, 1886, is extended to 12 o'clock noon, March 15, 1887, at which hour the opening of the bids will take place.

WILLIAM C. WHITNEY,
Secretary of the Navy.

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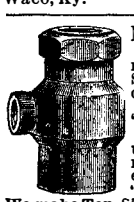

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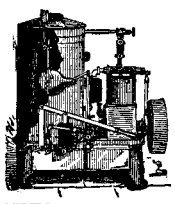

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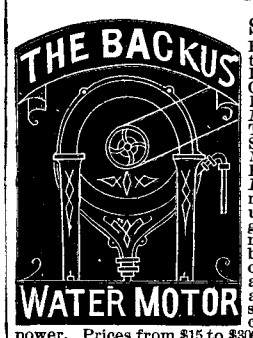

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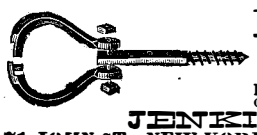

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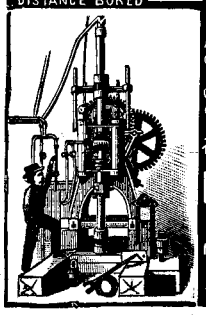

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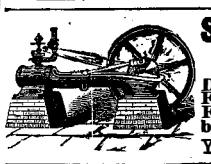

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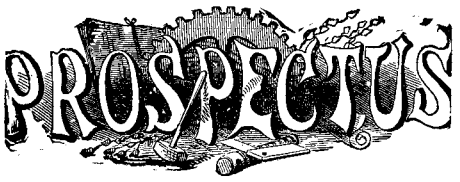

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